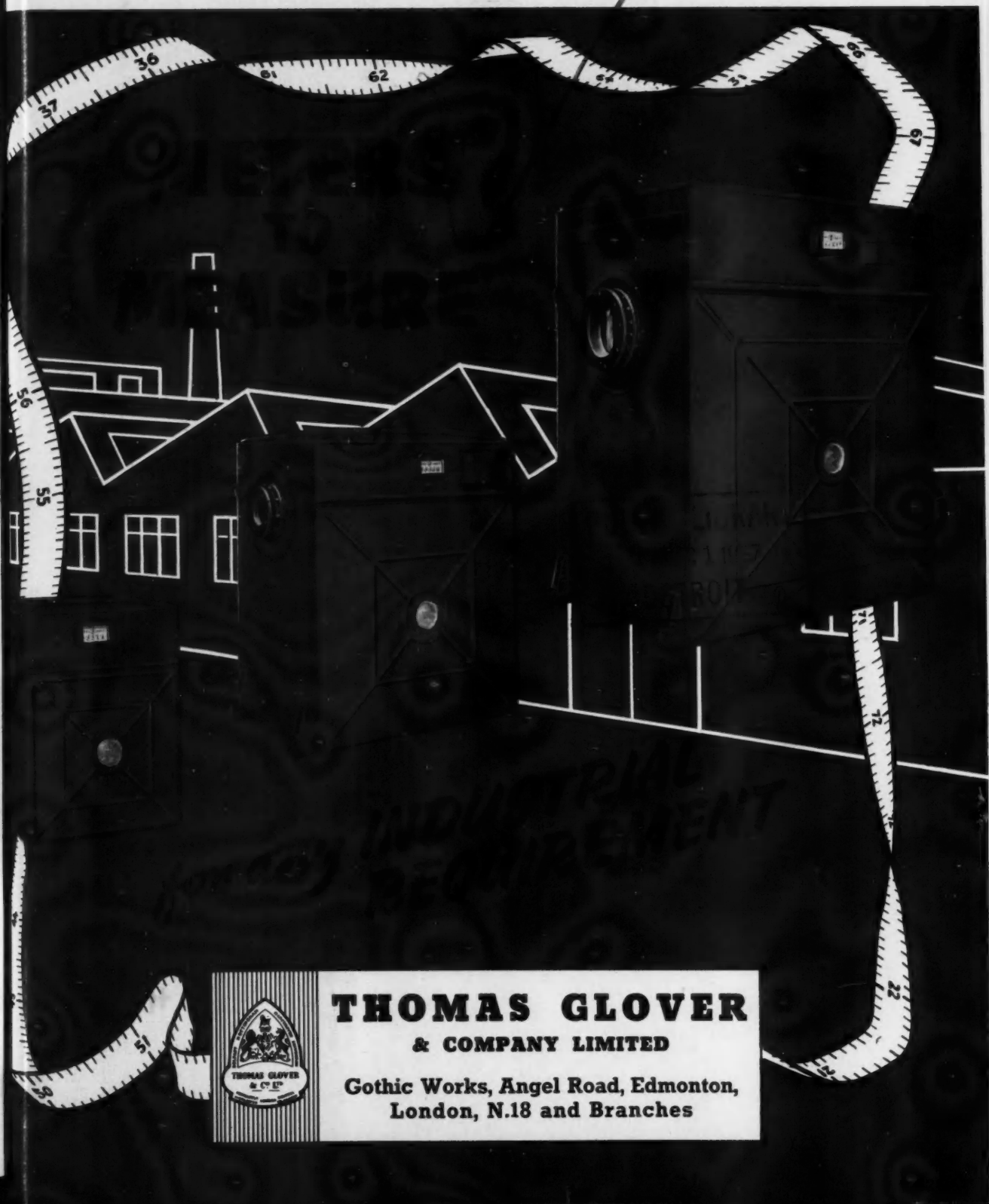
TECHNOLOGY DEPT.

Gas Journal

VOL. 289. 109th YEAR. LONDON, FEBRUARY 6, 1957. No. 4882. PRICE 1/6



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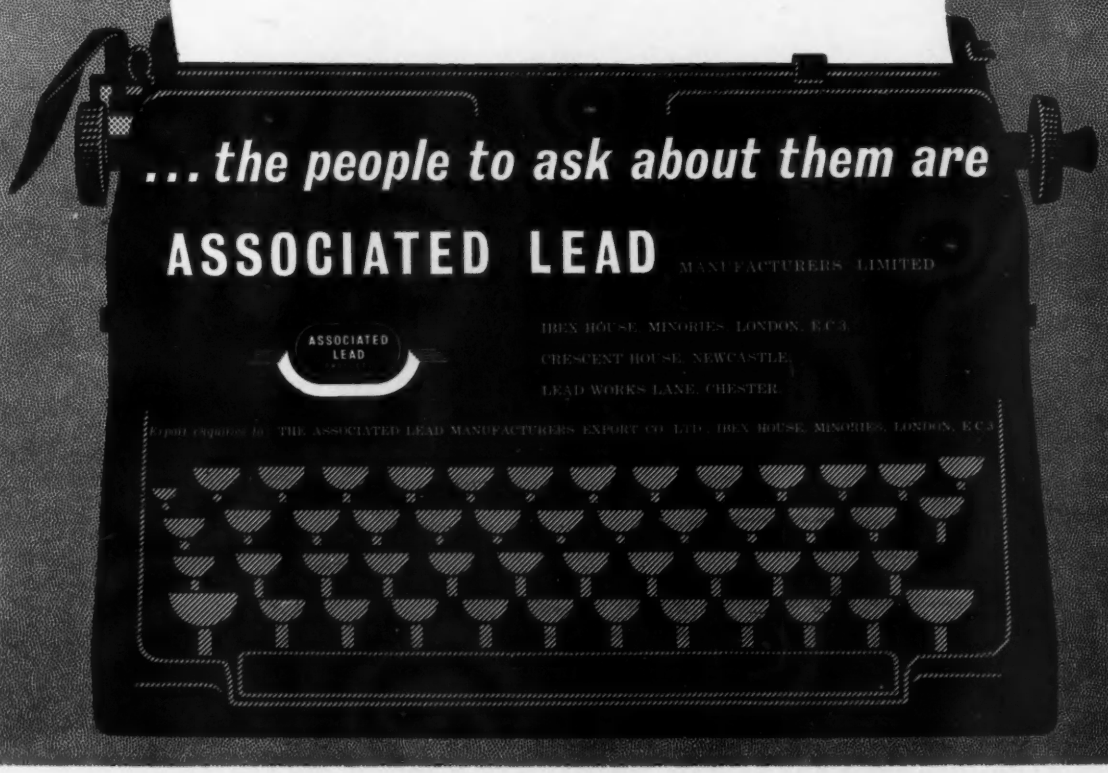

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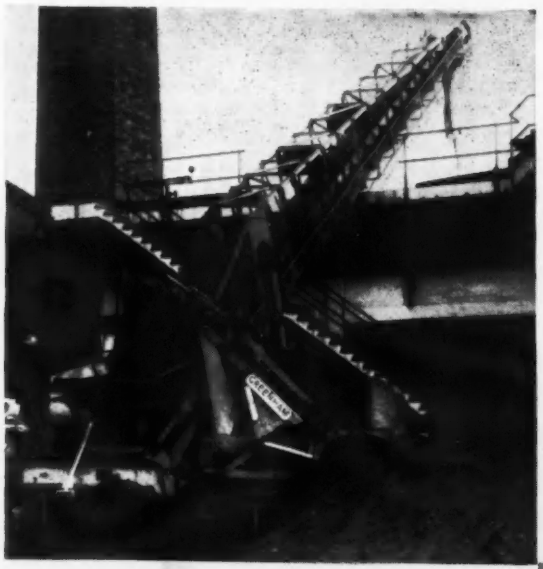

The 24" BTR belt on this 70 ft. Crone and Taylor Super Mobile Conveyor has heavy work to do, lifting oxide into the purifiers at a Gas Works. For oxide is a difficult load for belting—wet and clinging, with 20 per cent. or more of moisture, it is capable of tearing the slats out of all but the stoutest carcass — a real test of belt strength and of ply-to-cover adhesion.

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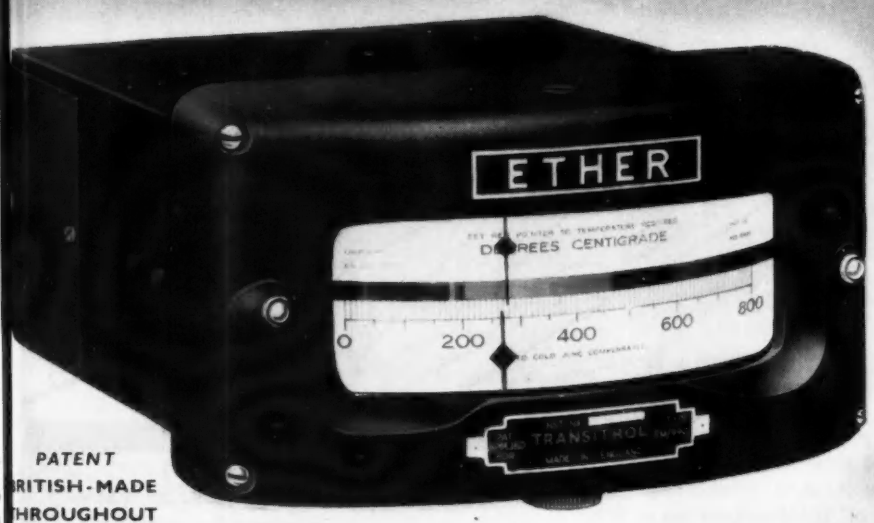

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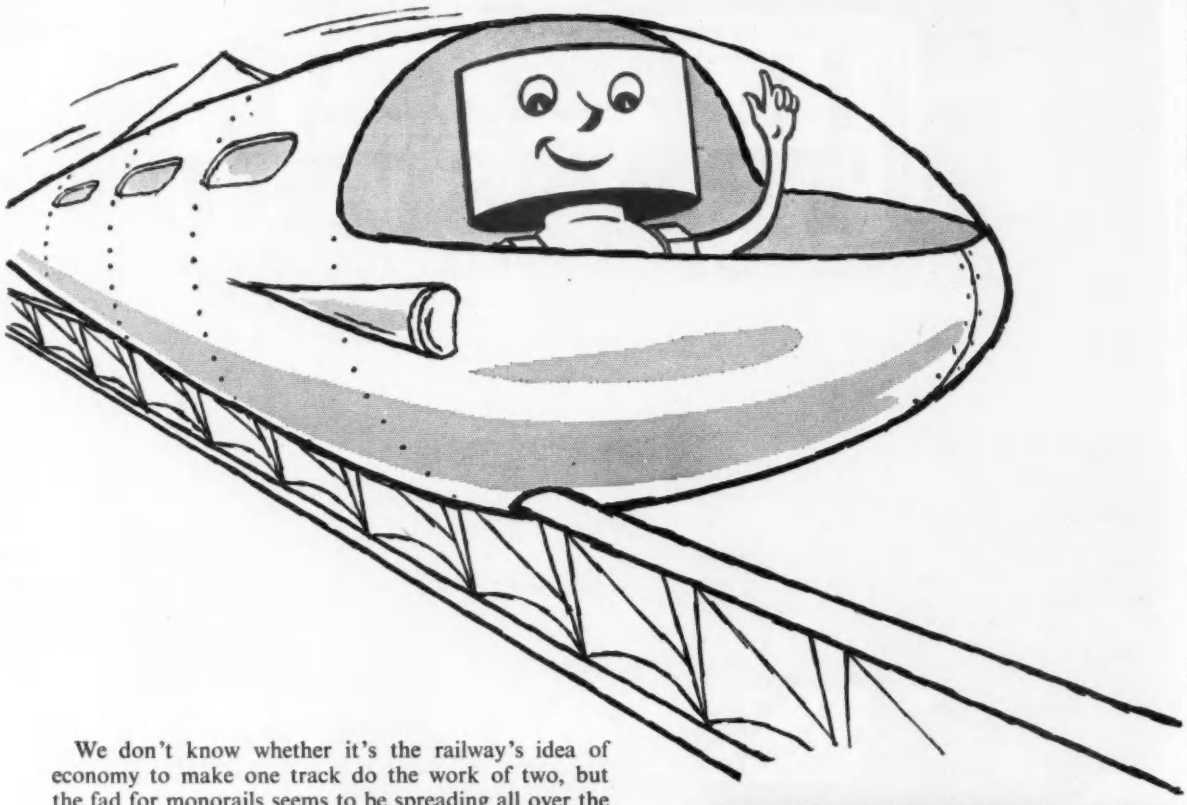

We don't know whether it's the railway's idea of economy to make one track do the work of two, but the fad for monorails seems to be spreading all over the place. They tell us they go faster, smoother, safer, quieter — but we two-footed ancients have an ingrained distrust of anything lacking inherent equilibrium. Of course, it's all a matter of reliable controls — our slide-rule wallahs tell us they are foolproof and safe.

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M.V. 16

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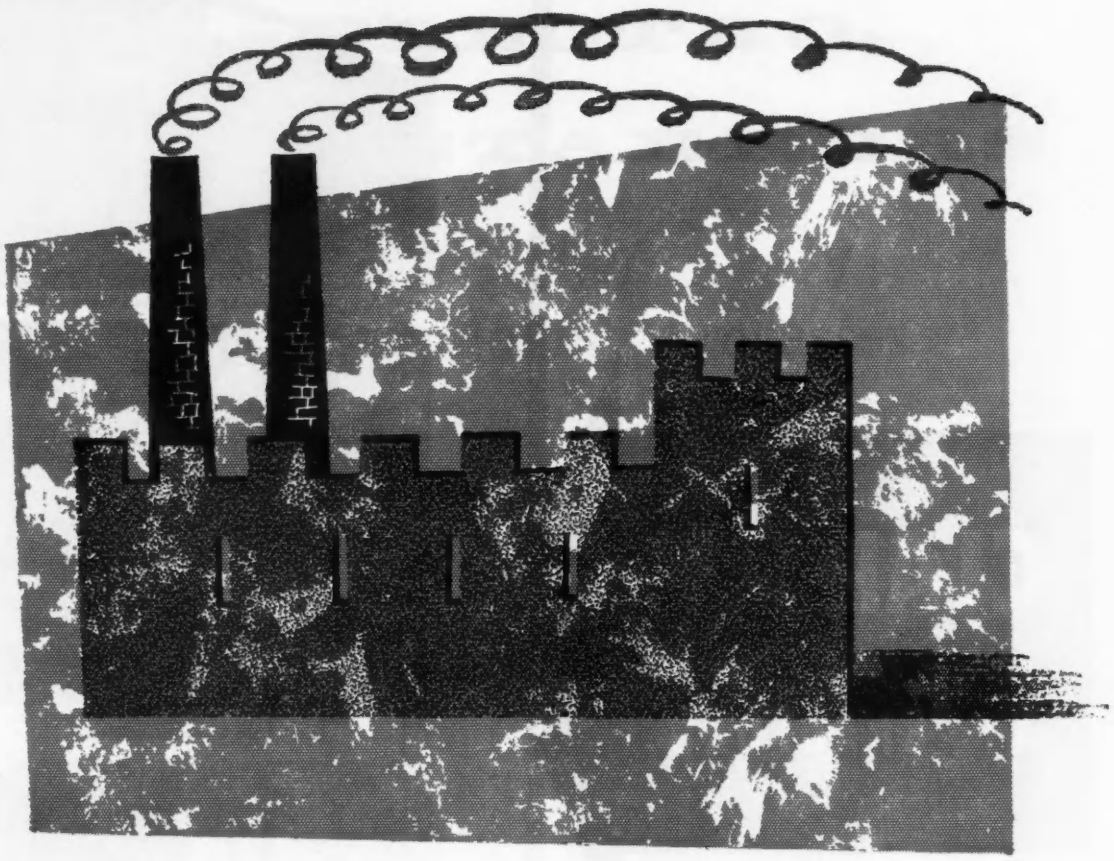

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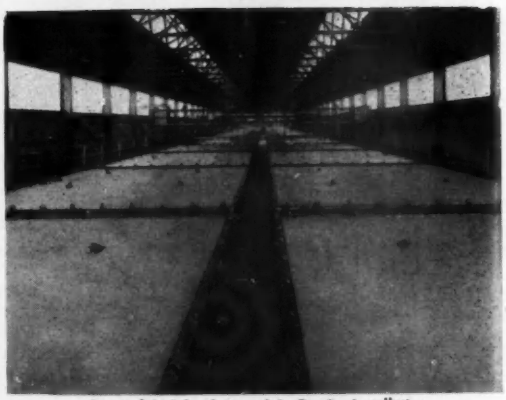
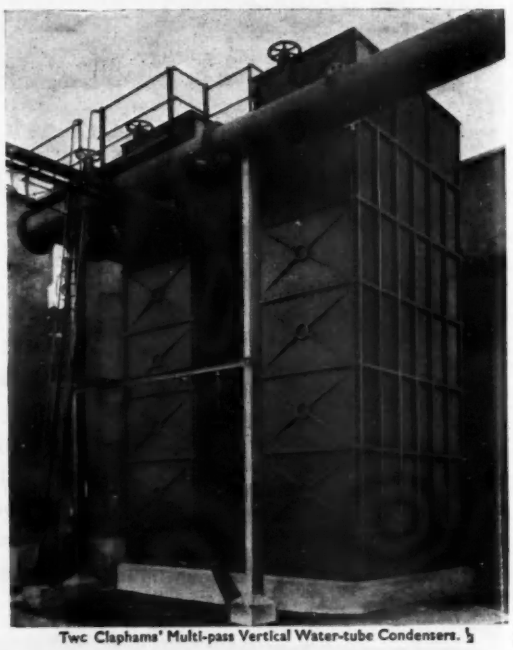


Internal deck level view of the Purifier Installation. (Eight 45 Feet Square Boxes)



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*1 Kensal Green N.T.G.B.	1	Cold G.I. „ ...	6
2 Sydney, Australia	2	High B.T.U. Oil Gas	13
* Stratford N.T.G.B.	1	C.W.G. (Heavy oil)	15½
2 Watford E.G.B.	1	Complete Gasification	4½
* Surabaya (Indonesia)	1	ONIA-GEGI	4
*3 Warrington N.W.G.B.	1	C.W.G. (Heavy oil)	11
Ponders End E.G.B.	1	Segas	8
*3 Portsmouth S.G.B.	1	ONIA-GEGI	11½
2 Uxbridge N.T.G.B.	1	Segas	4
*4 Gloucester S.W.G.B.	2	Hot G.I. (Comp. Gasification) ...	15½
*4 Gloucester S.W.G.B.	1	Cold G.I. „ ...	10

NOTES

*Detarrers handling cyclic gas before the relief holders.
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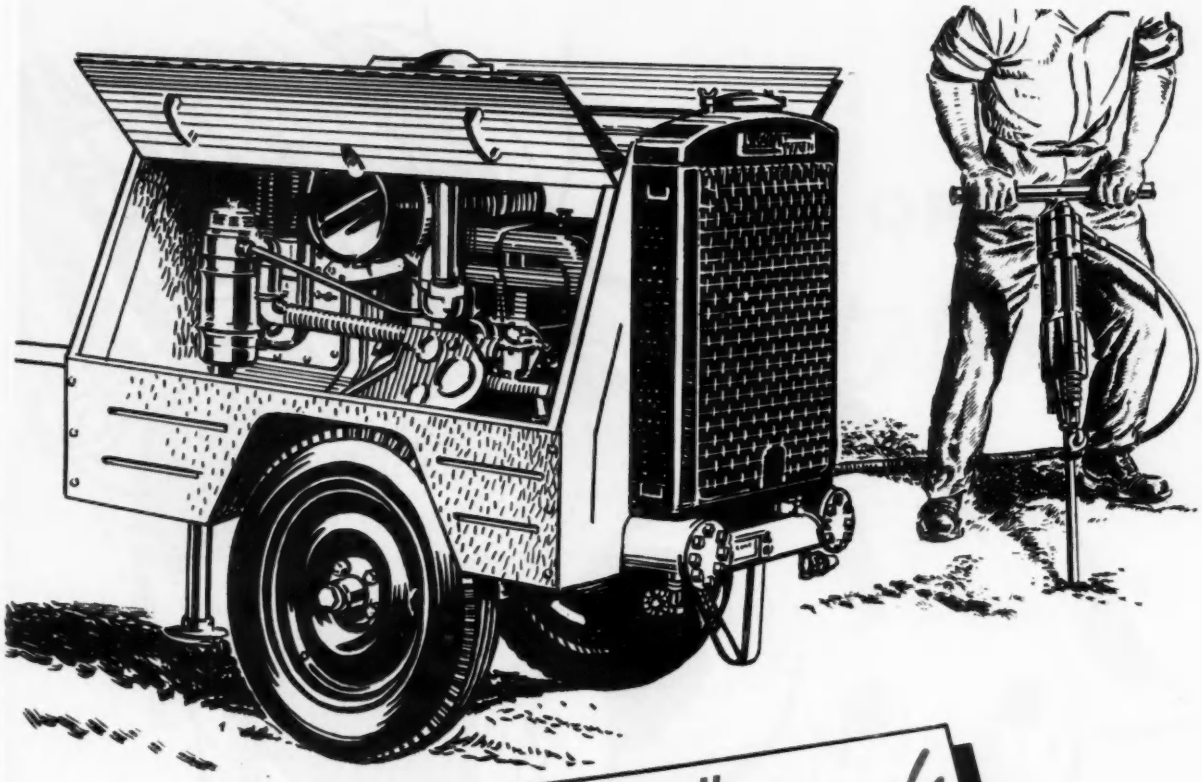

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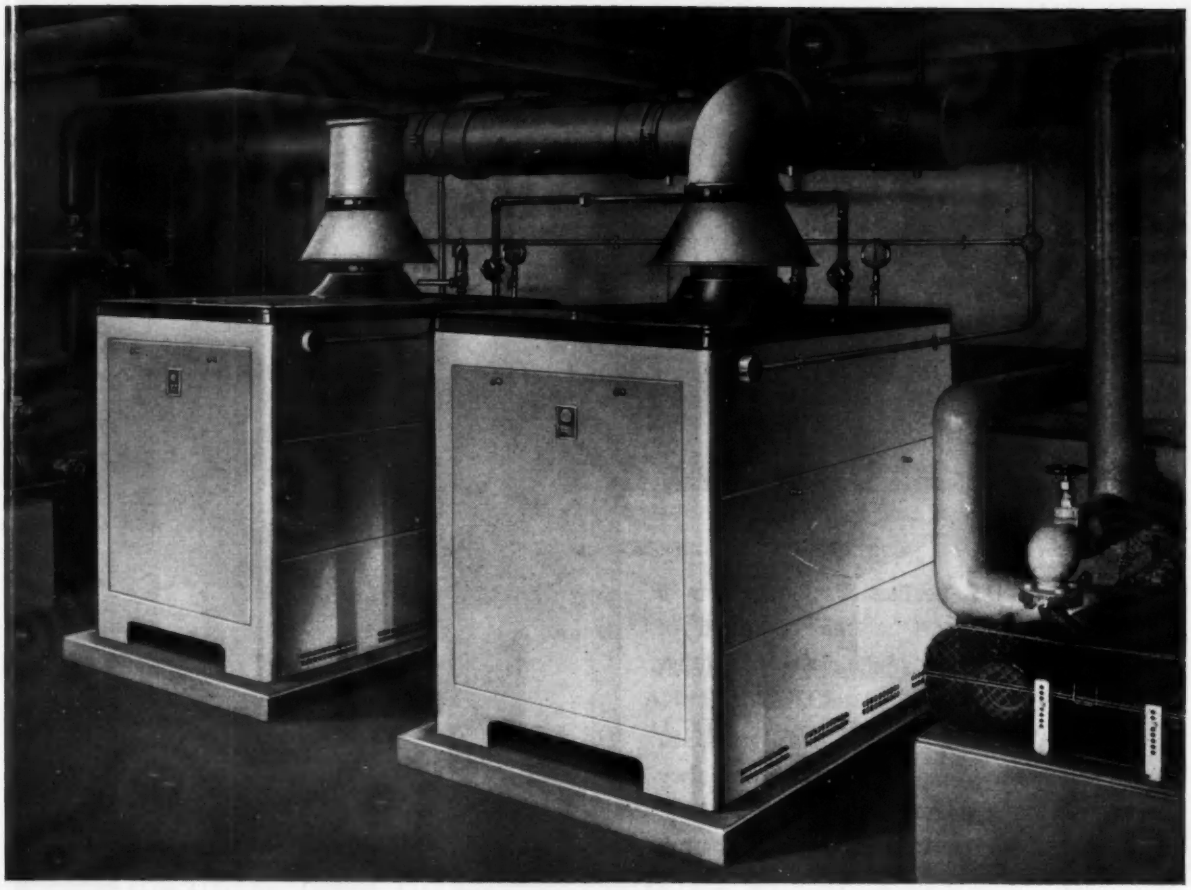

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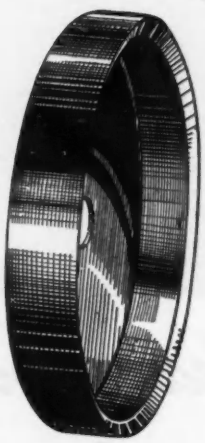

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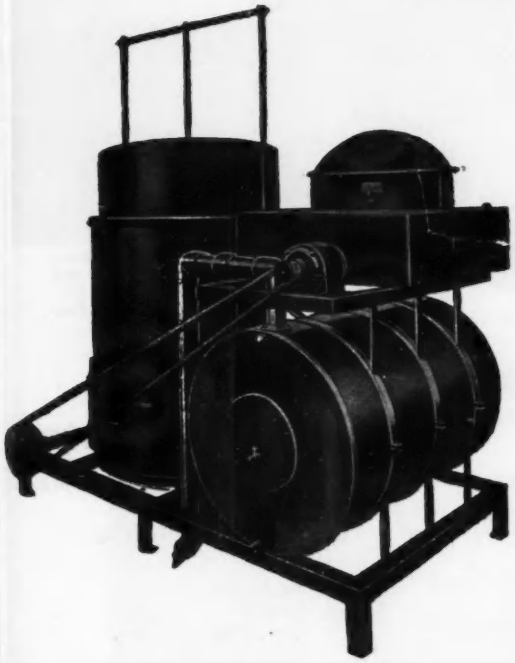

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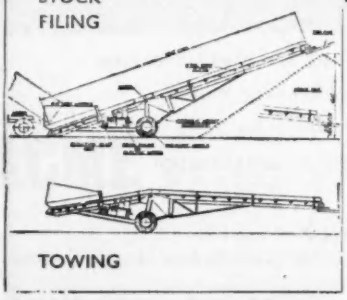

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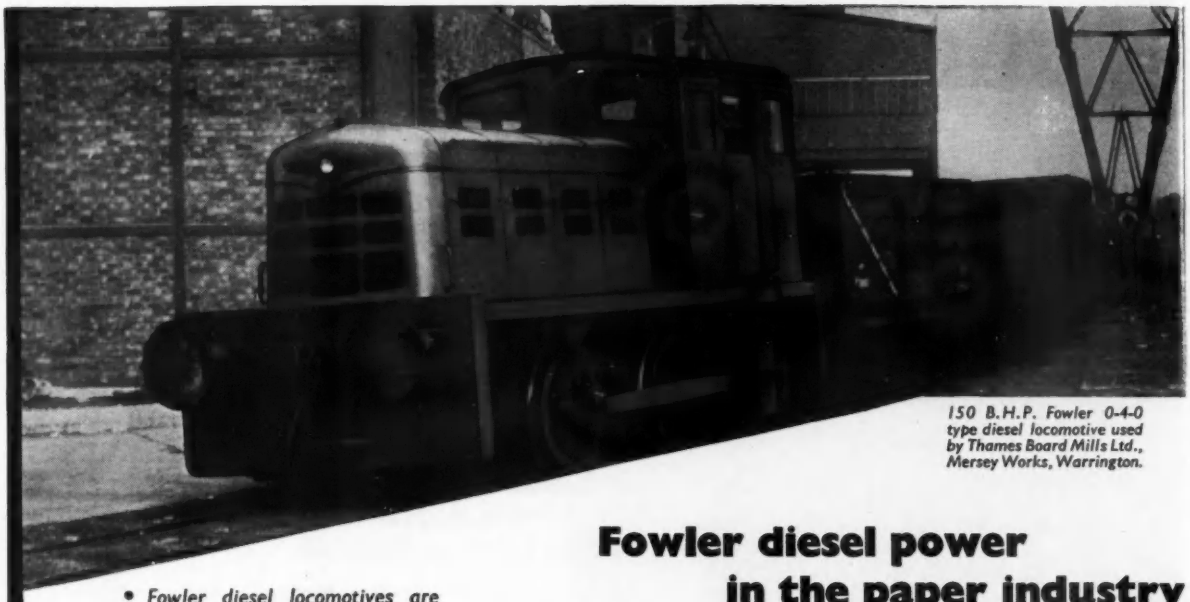

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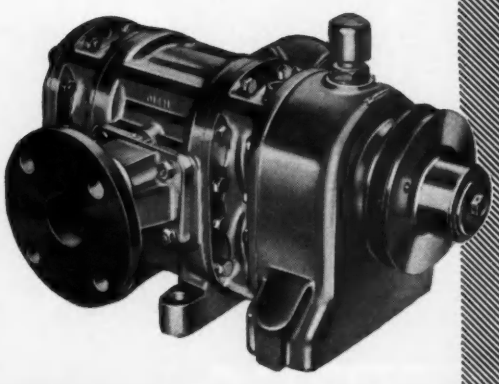

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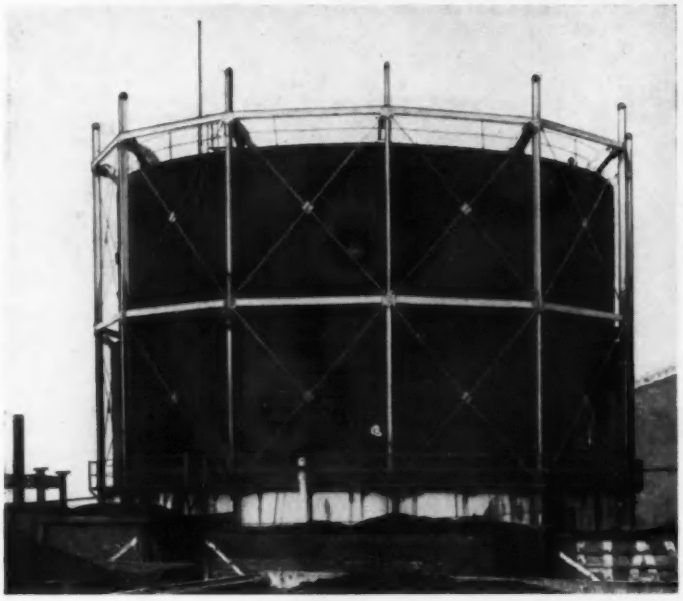

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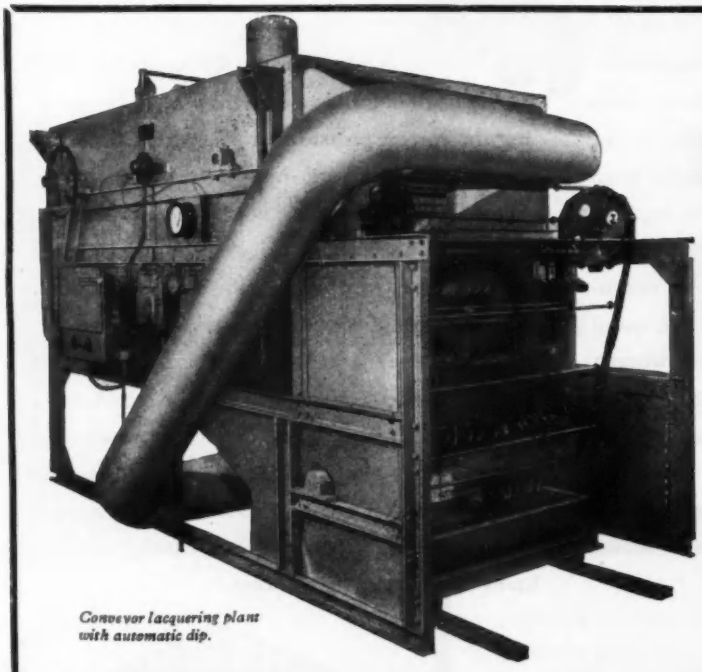

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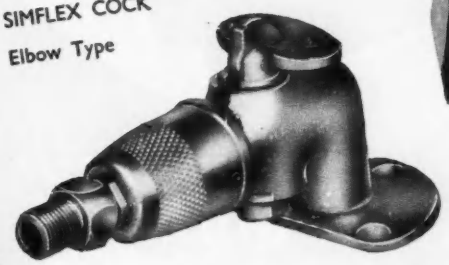

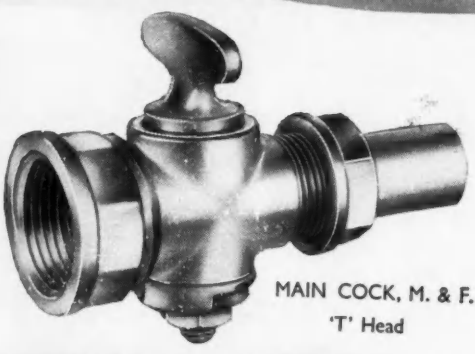

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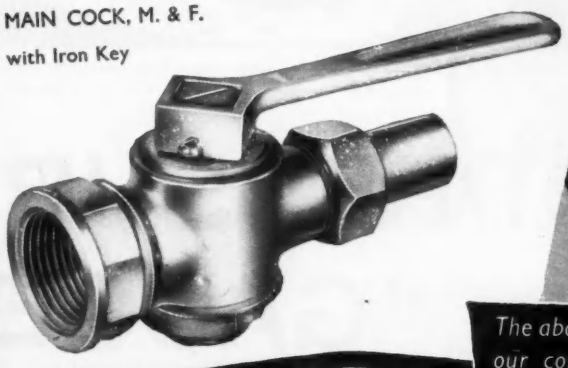

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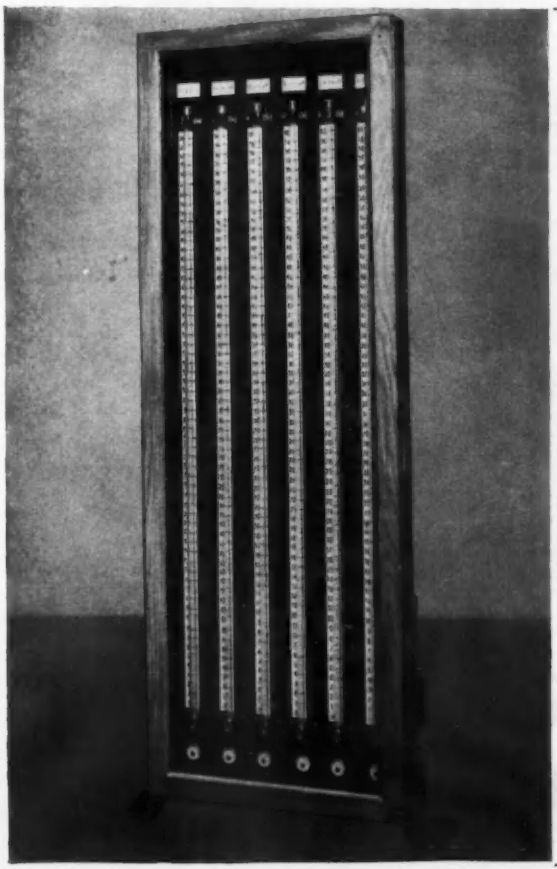

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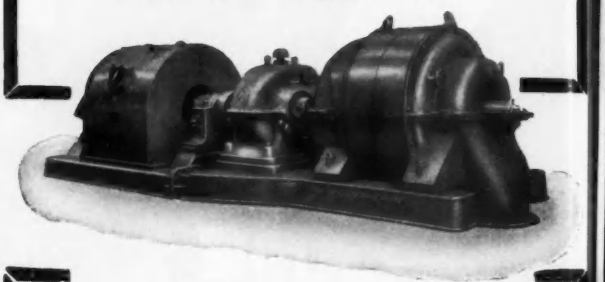

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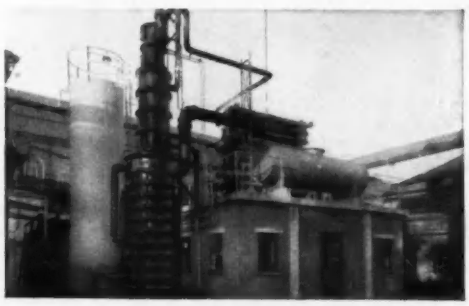

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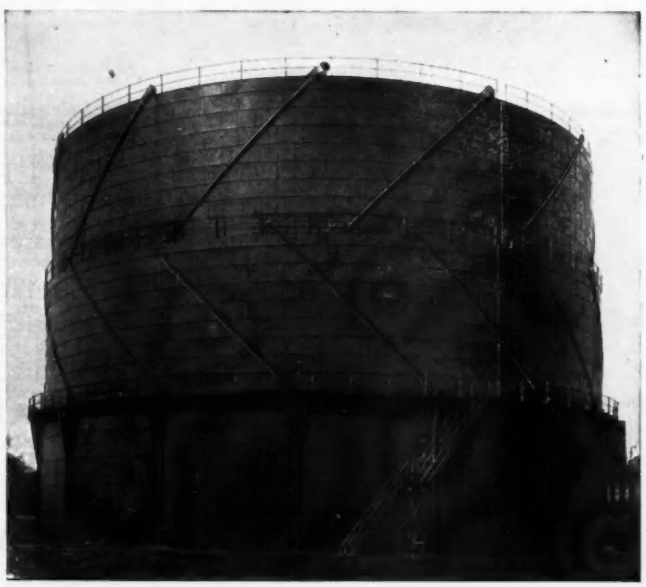

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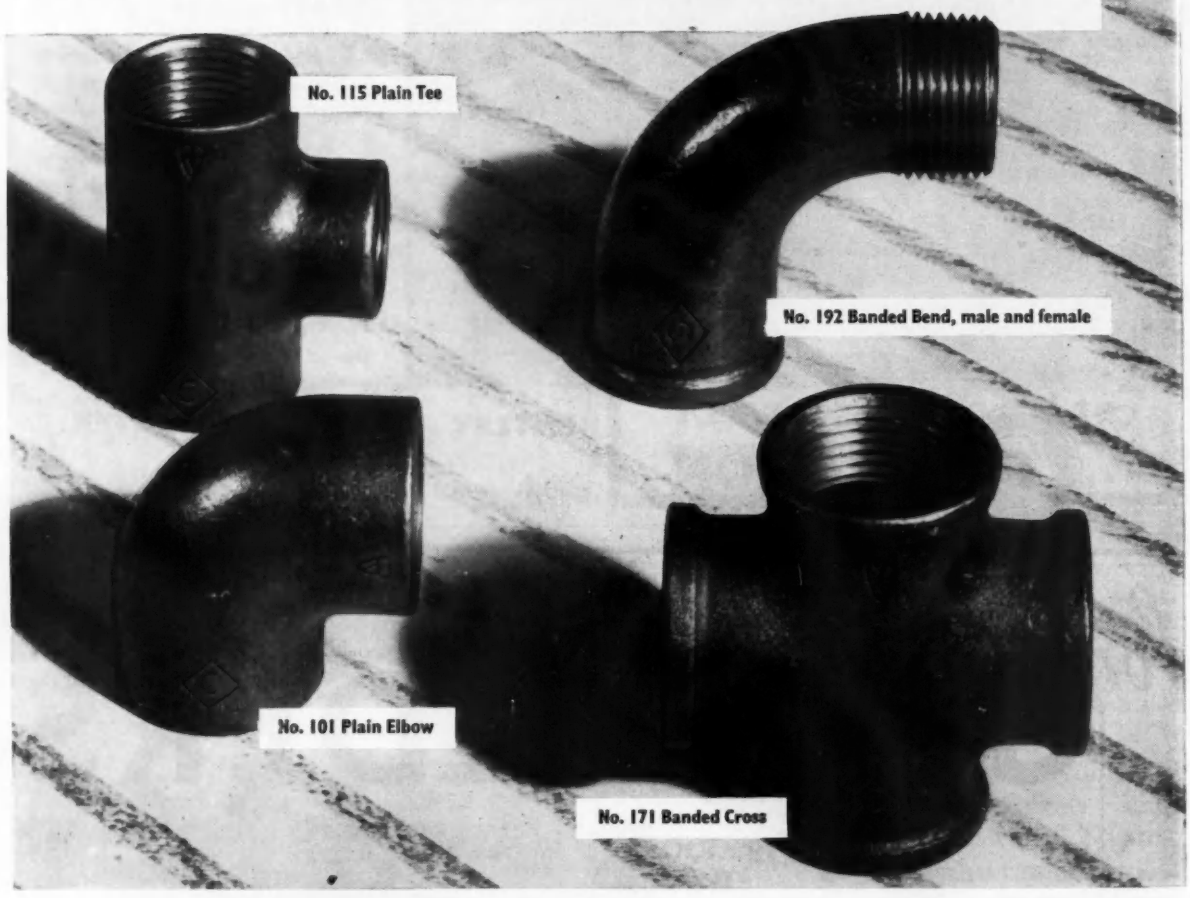

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INDEX TO 'JOURNAL' ADVERTISERS

	PAGE
A	
A.C.E. Machinery, Ltd.	
Abbott, Birks & Co., Ltd.	
Acme Wringers, Ltd.	275
Aerogen Co., Ltd.	273
Air Control Installations, Ltd.	
Alder & Mackay, Ltd.	
Aldridge & Ranken, Ltd.	
Allan Taylor (Engineers), Ltd.	
Ascot Gas Water Heaters, Ltd.	
Ascot Gas Water Heaters, Ltd. (F. A. Nest) ...	
Ashmore, Benson, Pease & Co.	
Ashworth & Parker, Ltd.	
Aspinall's (Paints), Ltd.	
Associated Lead Manufacturers, Ltd.	258
Atlas Preservative Co., Ltd.	
Audley Engineering Co., Ltd.	
Automatic Telephone & Electric Co., Ltd. ...	
Automotive Products, Ltd.	
Averill, C. R., Ltd.	
B	
Bale & Church, Ltd.	313
Balfour, Henry, & Co., Ltd.	
Bayley, Thos., (Great Bridge), Ltd.	
Bergwaco Meters, Ltd.	
Blakeley, Firth, Sons & Co., Ltd.	281
Bolton's Superheater & Pipe Works, Ltd. ...	
Bratt Colbran, Ltd.	
Bray, George, & Co., Ltd.	
Bray, W. E., & Co., Ltd.	
Bristol Pneumatic Tools Ltd., ...	
British Carbo-Norit Union, Ltd.	312
British Gas Purifying Materials Co.	
British Jeffrey-Diamond, Ltd.	
British Oxygen Linde Ltd.	
British Paints, Ltd.	
British Rototherm Co., Ltd.	
British Thermostat Co., Ltd.	
British Thomson Houston, Ltd.	
British Tyre & Rubber Co., Ltd.	260
British Vacuum Cleaner & Engineering Co., Ltd.	Cover II
Broadbent, Thomas, & Sons, Ltd.	
Broom & Wade, Ltd.	267
Brown, J., & Co., Ltd.	
Bugden, Thos., & Co.	312
C	
Cambridge Instrument Co., Ltd.	
Cannon (G.A.) Ltd.	
Cathodic Corrosion Control, Ltd.	
Causeway Reinforcement Ltd.	
Cementation Co., Ltd.	281
Cheltenham Meters, Ltd.	
Chemical Engineering Wiltons, Ltd.	280
Cinema-Television, Ltd.	
Clapham Bros., Ltd.	264
Clayton, Son & Co., Ltd.	
Clensol Ltd.	
Clifford Engineering Co., Ltd.	312
Cochrane (Middlesbro') Foundry, Ltd.	
Cohen, George, Sons & Co., Ltd.	
Concrete Proofing Co., Ltd.	285
Consett Iron Co., Ltd.	
Controlled Flame Boilers, Ltd.	
Cort, Robert, & Son, Ltd.	
Crane, Ltd.	282
Crone & Taylor, Ltd.	273
Crosby & Co., Ltd.	
Crossley Bros.	
Crosthwaite Furnaces & Scriven Machine Tools, Ltd.	
Cutler, Samuel, & Sons, Ltd.	
Cuxson, Gerrard & Co., Ltd.	316
D	
Davenport Engineering Co., Ltd.	
Davey, Paxman & Co., Ltd.	
De la Rue, Thomas, & Co., Ltd. (Gas Group) ...	
Demolition & Construction Co., Ltd.	259
Dempster, R. & J., Ltd.	
Dempster, Robert, & Sons, Ltd.	
Denison & Son, Ltd.	
Derbyshire Silica Firebrick Co., Ltd.	
Diaphragm & General Leather Co., Ltd. ...	
Donkin (The Bryan) Co., Ltd.	Cover II
Douglas, Wm., & Sons, Ltd.	
Dowson & Mason, Ltd.	
Drakes, Ltd.	
Dresser Manufactures (England), Ltd.	
Drew, H. B., Ltd.	
Drummond Patents, Ltd.	
Dunlop Rubber Co., Ltd.	
E	
Eagre Construction Co., Ltd.	
Edgar, Wm. & Son Ltd.	
Eimco (Great Britain) Ltd.	
Elcontrol. Ltd.	
Electric Construction Co. Ltd.	
Electrolio Meters Co., Ltd.	
Electrolux, Ltd.	
Ellison, Geo., Ltd.	
Elliott Bros. (London), Ltd.	
Essard, Ltd.	
Essex Partners, Ltd.	
Ether, Ltd.	261
Evered & Co., Ltd.	
Ewart & Sons, Ltd.	
Ewart Chainbelt Co., Ltd.	312
F	
Falk Stadelman & Co., Ltd.	300
F. C. Construction Ltd.	
Fisher & Ludlow, Ltd.	
Fisher Governor Co., Ltd.	
Flavel, S., & Co., Ltd.	
Fluidrive Engineering Co., Ltd.	
Ford Motor Co. Ltd.	
Fowler, John & Co. (Leeds), Ltd.	274
Franki Compressed Pile Co., Ltd.	
Furse, W. J. & Co., Ltd.	
G	
Gas Purification, Ltd.	313
General Electric Co., Ltd.	
Gibbons Bros., Ltd.	
Gibbons Heurtey, Ltd.	
Girdex Engineering Co., Ltd.	
Glover, George, & Co., Ltd.	
Glover, Thomas, & Co., Ltd.	Cover I
Godfrey, Sir George, & Partners (Industrial), ...	274
Goodall Clayton & Co., Ltd.	
Goodyear Industrial Rubber Products, Ltd. ...	
Graphite Products, Ltd.	
Green & Boulding, Ltd.	
H	
Hamilton, A. H., & Co., Ltd.	
Hardman & Holden, Ltd.	
Harris & Pearson, Ltd.	
Harris Engineering Co., Ltd.	
Harrisons (London), Ltd.	
Harvey, G. A. & Co. (London), Ltd.	
Hick Hargreaves & Co., Ltd.	
Hilmor, Ltd.	316
Hills (West Bromwich), Ltd.	
Holman, Michell & Co., Ltd.	
Holmes, W. C., & Co., Ltd.	315
Holst & Co., Ltd.	
Hopkinsons, Ltd.	
Horseley Bridge & Thomas Piggott, Ltd. ...	
Horstmann Gear Co., Ltd.	
Howden, James, & Co., Ltd.	
Hudswell, Clark & Co., Ltd.	
Hughes, F. A., & Co., Ltd.	
Humphreys & Glasgow, Ltd.	
Hyde, Silas, Ltd.	276
I	
Ideal Boilers & Radiators, Ltd.	271
I.C.I., Ltd. (Metals Division)	
Inertol, Ltd.	276
Ingham, John, & Sons, Ltd.	
J	
Jeavons, E. E., & Co., Ltd.	
Jeavons Engineering Co.	
Jenkins, W. J., & Co., Ltd.	
Jenolite Ltd.	
Johnson, C. H., (Machinery), Ltd.	
Joy-Sullivan Ltd.	
K	
Keay, E. C. & J., Ltd.	
Keelavite Rotary Pumps & Motors, Ltd. ...	
Keith Blackman, Ltd.	316
Kings Patent Agency, Ltd.	313
King, Walter, Ltd.	312, 313, 314
Kirkham Hulett & Chandler, Ltd.	
L	
Lafarge Aluminous Cement Co., Ltd.	
Lamont, James H., & Co., Ltd.	
Le Bas Tube Co., Ltd.	
Leeds Fireclay Co., Ltd.	
Lee, Howl & Co., Ltd.	
Lincoln Electric Co., Ltd.	
Lionweld, Ltd.	
Lind, Peter, Ltd.	
Liptack Furnace Arches, Ltd.	
M	
MacLellan, George & Co., Ltd.	
Macpherson, Donald, & Co., Ltd.	
Magnetic Valve Co., Ltd.	262
Main, R. & A., Ltd.	308, 309
Major Robinson & Co., Ltd.	
Manesty Machines, Ltd.	
Mapel Metal & Pipeline Endurance, Ltd ...	266
McNeill, F. & Co., Ltd.	280
Maun Decorators.	
Meltham Silica Fire Brick Co., Ltd.	
Messengers & Sons (Birmingham) Ltd. ...	
Meters Ltd.	Cover IV
Metropolitan Gas Meters, Ltd.	
Metropolitan Vickers Electrical Co., Ltd. ...	
Midland Iron & Hardware Co. (Cradley Heath), Ltd.	
Milne (Edinburgh) Ltd.	278
Mint, Birmingham, Ltd.	
Mitchell Engineering, Ltd.	
Mitchell, H., & Co.	
Monitor Engineering & Oil Appliances, Ltd. ...	
Monk, A., & Co., Ltd.	
Mullan Bros., Ltd.	
Murex Welding Processes Ltd.	
N	
National Benzole Co., Ltd.	
National Enamels, Ltd.	
Neal, R. H., Ltd.	284
Neville, J. C., Ltd.	
New Conveyor Co., Ltd.	
Newton Chamber & Co., Ltd.	
Northern Manufacturing Co., Ltd.	
Norwest Construction Co., Ltd.	257
Nu-Swift, Ltd.	313
O	
Oxley Engineering Co. Ltd.	
P	
Parkinson & Cowan (Gas Meters), Ltd.	286
Parkinson Stove Co., Ltd.	304
Pass, E., & Co., Ltd.	
Peart, E. & Co., Ltd.	
Peebles & Co., Ltd.	279
Perl Controls, Ltd.	
Plenty & Son, Ltd.	
Pointer, Harcy (Norwich) Ltd.	
Power-Gas Corporation, Ltd.	
Press, William, & Son, Ltd.	
Pulsometer Engineering Co., Ltd.	
Pyrene Co., Ltd.	
R	
Radiant Heating, Ltd.	
Radiation, Ltd.	302, 303
Rawlplug Co., Ltd.	
Reavell & Co., Ltd.	280
Ride & Bell Ltd.	278
Roberts, R. E., & Sons, Ltd.	
Robinson, J. H., & Co. (Liverpool), Ltd. ...	277
Rotameter Manufacturing Co., Ltd.	
Royston, Geo., & Sons, Ltd.	
Rozalex, Ltd.	
Russell, R., & Sons	
S	
Salter, T. E. Ltd.	
Saunders Valve Co., Ltd.	
Sawyer, Geo. E., Ltd.	312
Scientific & Projections Ltd.	
Senior Economisers, Ltd.	
Shell Chemical Co., Ltd.	263
Siebe Gorman & Co., Ltd.	
Siemens-Schuckert (Great Britain), Ltd. ...	
Sigma Instrument Co., Ltd.	
Silvertown Rubber Company Ltd	
Simon Engineering (Midlands), Ltd.	
Simon, Henry, Ltd., ...	
Simon-Carves, Ltd.	
Simon, Richard, & Sons, Ltd.	
Sisson, W., & Co., Ltd.	
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Smith Meters, Ltd.	
Smith, Thos., & Sons (Rodley), Ltd.	
Spencer-Bonecourt Clarkson, Ltd.	
Sperryn & Co., Ltd.	
Stanton Ironworks Co., Ltd. ...	facing p. 293
Staveley Iron & Chemical Co., Ltd.	
Stein, John G., & Co., Ltd.	
Stewart & Gray, Ltd.	
Stewarts & Lloyds, Ltd.	
Stillite Products, Ltd.	
Stoves, Ltd.	269
Strachan & Henshaw, Ltd.	
Stringer Bros.	
Sugg, Wm., & Co., Ltd.	
Summerson, Thos., & Sons Ltd.	
Sutcliffe Speakman & Co., Ltd.	
Sutherland, A. G., Ltd.	
T	
T & T Works, Ltd.	
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Turners Asbestos Cement Co., Ltd.	
U	
Underpressure Engineering Co., Ltd.	
United Gas Industries Ltd.	
Unit Superheater & Pipe Co., Ltd	
V	
Vaughan, Edgar, & Co., Ltd.	272
Vauxhall Motors Ltd, ...	
Victaulic Co., Ltd.	
Visco Engineering Co., Ltd.	
W	
Wadsworth, Wm., & Sons Ltd.	
Wakelin, F. H., Ltd.	
Walker Bros., Ltd.	270
Walker, C. & W., Ltd.	
Walker, Crosweller & Co., Ltd.	
Walkers (Century Oils) Ltd.	
Waller, George, & Sons, Ltd.	
Walter King, Ltd.	312, 313, 314
Ward, Thos. W., Ltd.	
Warsop Power Tools, Ltd.	
Weir, G. & J., Ltd.	
Wellington Tube Works, Ltd.	
Wellman Smith Owen Engineering Corpn., Ltd.	
West, Allen & Co., Ltd.	
West's Gas Improvement Co., Ltd. ...	Cover III
West's Piling & Construction Co.	
Westwood & Wrights, Ltd.	312
Whessoe, Ltd.	265
Whitley Moran & Co., Ltd.	312
Whitlock Bros. Ltd., ...	
Whittaker Ellis Ltd.	
Whittall's of Birmingham.	
Widnes Foundry and Engineering Co., Ltd. ...	
Wilkes, A. H., & Co., Ltd.	
Williamson, Cliff, Ltd.	
Wilson, George, Gas Meters, Ltd.	
Winn & Coales, Ltd.	268
Woodall-Duckham Construction Co., Ltd. facing p.	292
Wood, Hugh, & Co., Ltd.	
Y	
Yorkshire Copper Works, Ltd.	
Agencies	
Appointments Vacant	313, 314
Appointments Wanted	314
Books	
Contracts Open	
Educational	
Fellowship	
Miscellaneous	
Patents	313
Plant &c. For Sale	313
Publications	
Public Notice	

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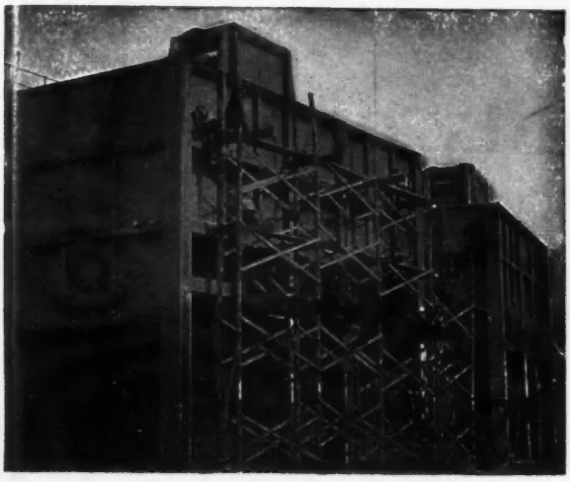

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VOL. 289 NO. 4882 February 6, 1957

109TH YEAR

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CONTENTS

EDITORIAL COMMENT

Mechanisation for Distribution Engineers 287
Automation 288

NEWS OF CURRENT EVENTS

Personal 289
Diary 289
255 Factory Gas Mishaps During 1955 289
Four Little Mice Meter Sticky End! 289
H.P. Curbs to Stay, Says Sir David 289
Big Scottish Administration Changes 290
Eye-level Grill Safety Report 290
Clean Air Means More Work for S.S.F.F. 290
H. & G. to Make American-type Atom Reactor Components 291
Women's Organisations Meet at Watson House 291
Oil: N.G.B. Report 50% Intake Slash 291
Council Protest Over L.C.C. Coke Store Decision 291
Gasworks Fire 291
Trade News Supplement 310

TECHNICAL RECORD

Domestic Heating 292
Gas on the Continent 293
Mechanisation—Some Experiences in its Application to Pipe-laying and Maintenance. By B. G. Hawkings 294
Reorganisation in Gaz de France 299
Application of Mathematical Techniques to Gas Research Problems. By E. Woodcock 301
The Load Factor. By D. R. Adams 306

PUBLISHERS' NOTICE, SEE PAGE 313

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Gas Journal

VOLUME 289. No. 4882. FEBRUARY 6, 1957. 109th YEAR

Mechanisation for Distribution Engineers

WE are continually hearing of the wonderful organisation there is in America for excavating and pipe-laying by machinery, with the implied criticism that nothing of the sort is ever done in Great Britain. It was a pleasant surprise therefore to encounter the paper by Mr. B. G. Hawkings of the Warwickshire Division, Coventry District, West Midlands Gas Board, which he read recently to the Midland Juniors. In his paper Mr. Hawkings not only describes with considerable detail the machines that are available but also the pitfalls which must be avoided in their use.

America is a big country which seems to have its oil and natural gas supplies tucked away in very definite areas. These do not happen to be the most densely populated and therefore are not potentially large consumers of gas. To reach the consumers pipelines 1,000 miles long and more are needed. Such a project is the mechanised excavator's dream. Here is open country, virgin ground which is not cluttered up by the underground services of other public utilities. Such country on a much smaller scale may be found in the more remote rural districts of our area boards, such as North Wales. Here the latest excavating machinery was obtained for the laying of the North Wales grid pipeline, which had the distinction of a preliminary survey by helicopter, but such pipelines tend to be an exception and it is much commoner for the area boards to lay mains out to the new housing sites to be found round our large towns and cities. Though suitable for using a mechanical excavator, there is a tendency for these excavators to do their work too quickly and then stand idle. This point is made most clearly by Mr. Hawkings in his description of the two main types, the endless chain dredger type of bucket excavator and the single-bucket back-actor. While it is working the dredger type of excavator is probably the most efficient, as it works continuously, moving along a predetermined line at a constant crawling speed, whereas the single-bucket back-actor grabs the earth out of the trench and deposits it to one side. Although it may be working without break, its action wastes a considerable amount of excavating time. Why use this type? The answer is that it can be used as a dual purpose machine and is far more mobile. By altering the bucket and jib arrangements, this machine can be converted to do the work of a mechanical navvy, and by mounting it on a suitable chassis it can move on pneumatic tyres. By substituting a hydraulic mechanism all the wear and tear on actuating wire-ropes and pulleys can be avoided.

The test of which machine is the most suitable appears to be not so much a question of which is the best excavator but which is the most adaptable to other work, costs less to maintain, and is most mobile.

In other words, it is no good buying a mechanical excavator unless it can be guaranteed almost continuous work. It might seem strange that there should be any doubt about finding continuous work for such machines when the difficulties over getting the type of manpower needed for excavation work are considered, but even with the extension of grid systems, the routes followed by so many of the pipelines are down main roads where equipment is needed for breaking up the road surface before the excavator can be used. The latest type of back-actor excavators are being fitted with power off-takes driving small compressors for pneumatic road breakers, but it is generally considered that a mobile or transportable compressor is the more satisfactory.

Here again the choice of compressor plant is considered by Mr. Hawkings, the big transportable type which needs to be towed by another vehicle or a tractor-mounted self-propelled type. The former type can be fitted with lockers for the breaker equipment, hoses, connectors, etc., but unless the compressor is to remain some time at the one site, it is going to tie up its towing vehicle, generally a lorry which could be used for other work. The tractor-mounted model, on the other hand, would need to tow another vehicle to contain its equipment, which Mr. Hawkings points out, generally gets

mislaid in an emergency. Such a towed vehicle is often a service layer's cart fitted with pneumatic tyres and conforming with the Road Licensing Authority's regulations; it therefore forms a most mobile main layer's ensemble. In fact the Coventry District have such a combination standing-by for emergencies.

Mr. Hawkings refers to other means of easing the work of the distribution department. Such devices as a hydraulic service pipe compressor borer for negotiating long traverses under concrete carriageways when the single main system of gas supply is practised for new housing estates, and the equipping of a lorry with a jib attachment for handling mains and service pipes are both suggestions that have been successfully carried out in practice in the Coventry District.

But it all depends on how much use the particular piece of equipment can be put to, to justify the capital costs. In Mr. Hawkings' view there are factors which justify the use of such equipment, and in districts where house estates are being built there is plenty of work for it to do. The smallest administrative unit which would have enough work to justify its use would be a group or division. Some would recommend their use but deprecate the owning of such plant, and in their opinion it would be more profitable to hire it. In the long run this may be the solution.

Automation

MR. G. A. WOOD'S paper 'Automation in the Gas Industry,' presented to the Scottish Junior Gas Association last November, attracted less attention than it deserved. Perhaps this is because it covered somewhat too wide a field. What does 'automation' mean? Mr. Wood tells us that the word was first publicly used, if not invented, by an American, John Diebold, in his book, *Automation, the Advent of the Automatic Factory*, published in 1952 in New York and in this country by Macmillan. The author wanted a word to denote 'both automatic operation and the process of making things automatic.' He found the word automatisation both awkward and—from the standpoint of his weak spelling—hazardous, and confesses that it was the easy spelling that finally overcame his reluctance to coin a new word. A recent definition is, 'the automatic handling of parts *between* production processes.' Evidently therefore, automation denotes something more than mechanisation. It could mean automatic mechanisation, and it could include instrumentation. In the gas industry it could also include the notion of automatic scientific control. Instruments, with or without the assistance of electronics to make up for the very small forces at their disposal, may be used as links in the chain of automation.

Mr. Wood cites several examples of automation in other industries, mainly in the handling and treatment of homogeneous materials in repetitive processes and generally at normal temperatures. In more or less simple heating processes such a super-refined fuel as gas lends itself admirably to automatic control by way of the thermostat. He says: 'The use of automatic control instruments has long been practised in the gas industry for the production of the many by-products of the carbonising process. Without them it would be impossible to achieve the high quality of benzole products or the strict economy necessary when producing concentrated ammoniacal liquor.' And there are many applications in the distribution of gas some of which are cited by Mr. Wood.

In gas manufacture itself the greatest measure of automaticity has been achieved in the operation of water-gas plant and producers and no doubt automatic operation and control is a necessity in the manufacture of oil-gas. The mechanical producer, now coming into general use in the retort house, also lends itself to a considerable degree of automatic regulation and control, ensuring 'a gas, constant in both quantity and composition, giving improved temperature conditions in the retort setting and less flue cleaning, while dispensing with the labour of hand-clinkering operations.'

It is in the continuous vertical retort that the mechanisation of carbonisation has been brought to the maximum development but such is the heterogeneous nature and variation in composition and physical properties of the coal under treatment that automation is a long way off, even in this process. Perfection rather lies in the direction of adequate instrumentation so that the operator can be supplied with the utmost information relating to the condition of the charge, the temperatures and pressures in the setting and in the gas and coke outlets with mechanisation enabling him to adjust the several concurrent factors which influence the production of the maximum quantity of gas per ton and per retort at a constant calorific value.

The main effect of highly developed mechanisation in the increase of productivity, *i.e.*, in the reduction of man-power per unit volume of gas made, is shown in the examples of Scottish works given by Mr. Wood in the appendices of his paper. These are interesting if for no other reason than they show that a gasworks of moderate capacity but equipped with a compact highly mechanised plant, fully instrumented and with automatic control pushed to the practical limit, can show a higher productivity than a very much larger works where the plant is more varied in character.

Mr. Wood has included in his paper some notes on the mechanical or electrical computer, including the digital computer, but it will be agreed that these are a study in themselves, not very relevant to the complex problems of gas manufacture. These devices would appear to be applicable to the accountancy sides of the business. 'The difficulty associated with any assessment of the chemical and physical characteristics occurring in a chemical process is probably the greatest single factor against an early application of the computer to process control,' says Mr. Wood.

The modern carbonising plant is so mechanised and instrumented that a very high efficiency can be realised in it—but to do so requires the addition of the human brain to the aids of scientific control. It has been suggested that, with the assistance of electronic devices, throughput could be controlled from the calorimeter. But if the variation of this factor were large, concomitant factors would also need adjustment. The business of the designer is to provide equipment so that observations of conditions at all points can be quickly made (and with sufficient accuracy) so that intelligent adjustments can be made readily. The operative word is 'intelligent.' Optimum results will be obtained by intelligent operation. Automation pushed too far may end in mediocre average results.

Personal Notes

MR. A. G. PALMER has been appointed Mechanical Assistant to the Chief Engineer, North Thames Gas Board. Other Board appointments are: MR. W. K. HARDIE, Works Regulations Officer; MR. J. L. SMITH, Commercial Assistant to the Divisional Manager, Northern Division; MR. C. G. BALL, Warehouse Manager, Brentwood; MR. D. V. C. RYAN, Assistant Stores Superintendent; MR. F. W. W. BULL, Group Buyer, Buying and Contracts Department; MR. E. R. STREETER, Labour Officer, Transport Department. Certain officers in the Accountant's department, hitherto holding the title Head of Section, have now been given the title 'Section Accountant.' They are: MR. L. T. SCARSBROOK (general ledger); MR. W. F. F. BENTLEY (rents, rates and taxes); MR. G. DOMINY (wages and pensions); MR. E. HARRIS (process costs); MR. E. C. MORAN (cost office). Officers known at Watson House as Laboratory Leaders have now been given the title 'Officer-in-Charge' of the respective laboratory as follows: MR. E. W. B. DUNNING (cooking); MR. C. H. PURKIS (water heating); DR. F. A. BURDEN (coke); MR. E. A. K. PATRICK (industrial); MR. B. C. CARTER (mechanical); MR. D. R. WILLS (space heating); and MR. C. R. AUSTEN (meter). In the products sales department of the Board, the title of MR. H. J. CARTER has been changed to Sales Manager (Tar Products) and that of MR. C. J. JOHNSON to Sales Manager (Chemical Products).

MR. CHARLES ROBSON, a Director of Ashmore, Benson Pease & Company, Stockton-on-Tees, has been elected President of the Teesside Industrial Development Board.

MR. DUNCAN CAMPBELL, Chairman of Charles Carr, Ltd., and the Non-Ferreous Casting Co. (Birmingham), Ltd., is leaving on February 14 by the 'Reina del Pacifico' for the West Indies and Central and South America to help foster the Company's business interests abroad.

SIR HUGH BEAVER has resigned from the Council for Scientific and Industrial Research. As Sir Hugh has now become Deputy-President of the Federation of British Industries, he has been obliged to limit his other activities in consequence. He has served on the Council (and as Chairman of its predecessor, the Advisory Council) for four years.

DR. WILLIAM REID has been appointed Chairman of the Durham Division, National Coal Board, in succession to Mr. E. H. D. Skinner. The Minister of Power has agreed, at Dr. Reid's request, to the termination of his appointment as a member of the National Board to enable him to take up this appointment.

MR. S. A. MOUSLEY, General Sales Manager of Dunlop's general rubber goods division in Manchester, has been appointed General Manager of their belting division with headquarters at Speke.

Diary

February 8. — INCORPORATED PLANT ENGINEERS, BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, 7.30 p.m. Annual Dinner.

February 8. — SCOTTISH WESTERN JUNIORS: 522, Sauchiehall Street, Glasgow, C.2, 6 p.m. 'Corrosion Control,' G. B. Scott.

February 9. — EAST OF SCOTLAND JUNIORS, EDINBURGH: 'A Comprehensive System of Industrial Instrumentation,' Mr. W. Masterton.

February 13.—INSTITUTE OF FUEL: Institution of Civil Engineers, Great George Street, London, S.W.1, 5.30 p.m. 'The Rise of a Hot Waste Gas Plume,' Mr. C. H. Bosanquet, and 'Maximum Gas Concentration at Ground Level from Industrial Chimneys,' Mr. A. C. Best.

February 14. — BUILDING CENTRE FORUM: Store Street, Tottenham Court Road, London, W.C.2. 'Domestic Solid Fuel Appliances,' 6-7.30 p.m.

February 14. — WALES AND MON. JUNIORS, SOUTH WALES AREA: Cardiff. 'Pipe-line Butt-weld Inspection by Ultrasonic Methods,' Mr. W. Lloyd-Ellis.

255 FACTORY GAS MISHAPS DURING 1955

IN the section of his report for 1955 (Cmd. 8, H.M.S.O. 9s. net) dealing with industrial gassing mishaps, the Chief Inspector of Factories gives the total number of gassing accidents during the year as 255, a figure that has remained roughly steady since the end of the war. There were, however, only 11 fatalities in 1955 as against an average figure of 21 during the previous eight years.

The number of cases of poisoning by carbon monoxide reported during the year was 108 (including seven fatalities), compared with 113 cases (including 14 fatalities) during the previous year. Fifteen of these cases, including two fatalities which occurred in one accident, were due to blast furnace gas.

Five cases of H_2S poisoning were reported, compared with 13 cases, including two fatalities, in 1954. The five men concerned, in four accidents, were all rendered unconscious but recovered after treatment.

Fife County Council have agreed that the repair of gas and electric cookers in council houses should in future be the responsibility of tenants.

H.P. Curbs to Stay, Says Sir David

Question in House

THE President of the Board of Trade, Sir David Eccles, replying to a question in the House of Commons on January 31, said he had no intention of relaxing restrictions on the hire-purchase of gas or electric cookers and water heaters at the present time. He had received representations from the North Western Gas Consultative Council about the effect of these restrictions.

Saving Difficulty

Mr. F. Allaun, Labour, Salford E., had asked what representations the President had received seeking some easing of the present restrictions on the hire purchase of gas and electric cookers and water heaters. He also asked whether, in view of the difficulty for low-paid workers and old-age pensioners in saving the required deposit, he would consider easing the restrictions.

'Is the President aware,' he said, 'that there are working-class families and old age pensioners moving into corporation houses who cannot put down the 20% deposit, and consequently cannot cook a hot meal properly until they have saved that amount?'

Terms 'Compare Favourably'

Sir David: The terms of 20% deposit and a 48-months' repayment period compare very favourably with those of a number of other goods. I do not think we could alter this provision without raising a great many other questions.

FOUR LITTLE MICE METER STICKY END!

IN earlier days it was not uncommon for consumers who heard squeaking noises from their meters to report to the gas undertaking that they had mice in the meter. Now it has actually happened.

A Middlesbrough man who purchased a gas meter for filling gas bags on motor vehicles during the last year, had to remove the meter house to make room for building developments. He asked the Gas Board to report upon the condition of the meter, and when it was opened for examination, the corpses of four field mice were discovered.

The mice had climbed up a length of flexible hose attached to the outlet of the meter (which is valved at the inlet only) in search of warmth, and had then peacefully passed away.

BIG SCOTTISH G.B. ADMIN. CHANGES

Edinburgh and S.E. Merged; New Glasgow and Western Division

BIG changes have been made by the Scottish Gas Board in their scheme of administration throughout the country. Instead of the present seven divisions, each with a divisional controller, there are now five divisions, each headed by a general manager. The changes that have been made are:

The Edinburgh Division and the South-East Division have been merged into one unit, to be known as the Edinburgh and South-East Division. A small part of Dumfriesshire, taken from what was the Kilmarnock group of the South-Western Division, has been added to it.

The Glasgow and Western Division has been formed by the merging of Glasgow Division and the Western group of the South-Western Division, with important additions. It now takes in Glasgow, Dumbartonshire, Argyllshire, Buteshire, the whole of Ayrshire—and the Lanarkshire Division. This means the abolition of the Lanarkshire Division. It is understood that the reason behind the move is the possible development of the supplies of coke oven gas in Lanarkshire. It was felt to be better to increase the Glasgow Division to bring these supplies under the Glasgow General Manager.

The South-Western Division has been severely curtailed, having yielded Ayrshire, Renfrewshire, Buteshire, and a part of Argyllshire to Glasgow and Western and part of Dumfriesshire to Edinburgh and South-Eastern.

The Central and Northern Divisions remain unchanged.

EYE-LEVEL GRILL SAFETY REPORT

The possible danger of fat spilling from eye-level grillers on gas stoves on to the burners of the stove and so causing a fire has been investigated by the research department of the Gas Board at the request of the Stoke Newington home accident committee.

In a report on this, the department says experiments stress that there is less danger from fat spilling from the drip tray of the grill than there would be from a frying pan full of fat on the burners, as normally people do not use a lot of fat when grilling.

Clean Air Means More—Not Less—Work for S.S.F.F

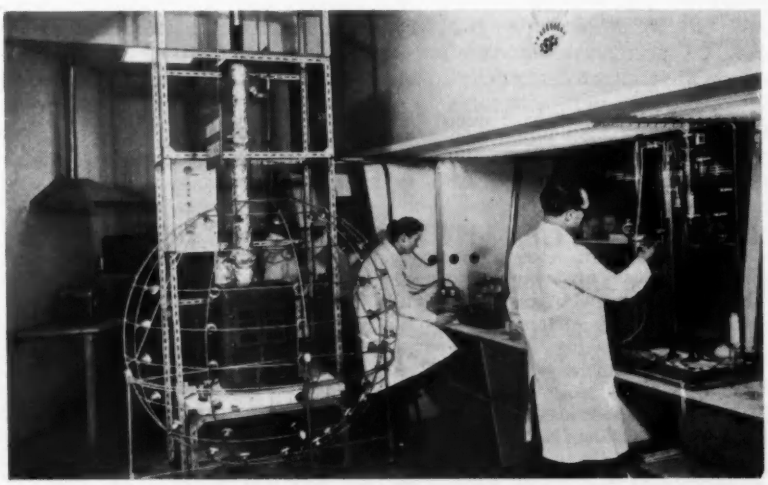
ANY suspicion that the enactment of the Clean Air Act, 1956, would lessen the work of the Solid Smokeless Fuel Federation was dispelled by its Chairman, Sir Henry Jones (Deputy Chairman of the Gas Council) when he explained the reasons for the Federation's latest exhibition at Charing Cross Underground Station—the fifth to be held there.

Speaking at a conference of representatives of local authorities, the Press and other 'interested parties,' held at the Charing Cross Hotel on Tuesday, Sir Henry said the Federation was more active today than it had ever been because, naturally, many local authorities were interested in creating smoke controlled areas under the Act and required advice. The exhibition showed some of the ways in which science had been brought to the householder who wished to avoid fouling the atmosphere.

Real Laboratory

The exhibition, which was opened by the Dowager Marchioness of Reading, Chairman and founder of the Women's Voluntary Services, is entitled 'The Scientist at your Hearth.' The main feature is an actual laboratory in which can be seen solid smokeless fuels and domestic heating appliances undergoing tests. For example, a proximate analysis of solid smokeless fuel—*i.e.*, a means of checking certain characteristics of the fuel which determine quality and suitability for the purpose—comprises measurement of moisture content, volatile matter content, ash content, and sulphur content, from which is deduced the percentage of 'fixed carbon,' the chief heat-giving constituent when the fuel is burnt.

A test for clinker formation provides a constant check on the quality of the fuel when produced. Visitors can also see tests for ease of lighting, intensity of heat radiation, etc., to determine the suitability of solid smokeless fuel for an ordinary modern inset grate, and tests on convector open fires and openable stoves. The latter include measurements of the flue gas temperature, draught and volume flow. The flue gas is analysed to determine its chemical composition, the temperature of the room being heated is constantly recorded, and from all these data the efficiency of the convector type of appliance can be determined with great accuracy.



A scene in the laboratory at Charing Cross

Display Panels

A series of display panels feature the plants producing different types of solid smokeless fuels and some of the most modern plants in this country producing the manufactured fuels are illustrated. The panel dealing with the natural fuels. Welsh anthracite and dry steam coal, illustrates the mining techniques employed.

A prominent feature is the panel illustrating the experimental plant for developing new carbonising techniques.

A special service bureau is running throughout the exhibition (which remains open until February 25) for the reception of the public, and local authority and other officials.

Campaigns

The campaigns of which the Charing Cross exhibition is a part are indicative of the educational work carried out by the Federation. Campaigns are running currently in the 'black areas' in response to requests from the local authorities concerned.

H. & G. to Make American-type Atom Reactor Components

HUMPHREYS & GLASGOW, LTD., whose history goes back to 1892 when the partnership was formed in order to introduce C.W.G. plant into Europe, and who have since become well-known throughout the world as gas plant manufacturers, last week staked their claim in the rapidly expanding nuclear power market. At a Press conference in London on January 29 many representatives of the gas industry heard the announcement that H. & G. have been awarded the sole rights outside North America in a reactor which has been developed by Alco (American Locomotive Company), New York, and which is essentially similar to the power unit of the United States submarine 'Nautilus.'

The terms of the agreement between the two firms provide that the manufacture of the components of any reactors which may be sold outside the United States should be carried out in the United Kingdom, but that the enriched uranium fuel for them would be provided by the United States Atomic Energy Commission. It would be returned to the U.S. for reprocessing after use.

Potential Market

The potential market for these small reactors, the first of which is now being built for the U.S. Army at Fort Belvoir, near Washington, lies in countries which have not yet developed or which have no reason to develop large electricity generating systems.

Power plants are at present available in three sizes, giving net electrical outputs of two, five and ten megawatts; but plans to extend the range up to 25 megawatts are in hand. When the Anglo-American agreement was announced it was stated that the ten megawatt station, which would supply a community of about 20,000 people, could be built on a site no larger than a lawn tennis court. The value of the installation would be about £2 mill., including the hire of fuel (which works out at £200 a kW. installed) and electric power would be produced at around 1¼d. to 2d. a unit.

Rear-Admiral Wilson D. Leggett, Vice-President of Alco products, said that one object of building these packaged atomic power stations in the U.K. was the fact that they hoped to reduce the cost of construction by undertaking as much as possible of the constructional work in the U.K. instead of the U.S.

Sense of Urgency

Mr. Ambrose Congreve, Chairman of Humphreys & Glasgow, Ltd., said that he was appreciative of the confidence which Alco Company had shown 'in giving us over half the world in which to operate, and it is our intention to press forward energetically and with a sense of urgency with this task of sales and development throughout our territory.'

Brigadier W. B. Sallitt, O.B.E., Head of the H. & G. Nuclear Engineering Division, said the fact that Alco had agreed that the manufacture of the reactor itself and of the ancillary plant should be carried out in the United Kingdom, meant that the export content of an overseas contract was very large and the dollar payment quite small. Alco possessed a wealth of manufacturing and operating 'know-how' which simply did not exist on any other reactor of comparable size. From this point of view Alco's reactor was at least three years ahead of its competitors.

How Grubby You Were, Our Grand-Children Will Say

CLEAN AIR DISCUSSION

IN 50 years' time our descendants will be astonished to think that 2½ mill. tons of soot, smoke and tar was launched into this country's air every year. This view was expressed by Dame Vera Laughton Mathews when she addressed a meeting of leaders of women's organisations at Watson House on January 29.

After a brief description of the Clean Air Act, mentioning especially its effect in the domestic sphere, Dame Vera said that if gas were cheaper, central heating by gas was an ideal method of keeping warm. Dame Vera is Adviser on Women's Affairs to the Gas Council.

Dr. F. J. Eaton, Deputy Manager, Watson House, said people were concerned as to whether there were going to be sufficient supplies of coke and other smokeless fuels to meet the needs of smokeless zones. But he thought there was no cause for concern as the controlled areas would come in very gradually.

Describing the smokeless fuels, particularly 'Phimax' and 'Cleanglow,' he explained how these are made from specially selected coals which in the past had been burned on the open fire and by the railways.

Dr. Eaton said: 'One-third of our coke goes into the domestic hearth, and it is very important that the right type of coke is used in the right appliances for the best efficiency.'

A demonstration on management and care of appliances by home service advisers of the North Thames Gas Board was followed by a talk by Mrs. Joan Robins, Chief Home Service Adviser of the Board, and a discussion.

OIL: N.G.B. REPORT 50% INTAKE SLASH

THE Northern Gas Board is managing to cut its estimated consumption of 25,000 tons of oil a year by about 50%, and has enabled other industries to effect savings by switching over from oil to gas for their power needs, said Mr. E. Crowther, Chairman, on January 28.

The amount of oil saved by industry's switch over to gas in the region could not be accurately estimated because many had not notified the Board, but some indication could be gained by the fact that one firm's changeover to gas was enabling it to reduce oil consumption by 1,500 tons a year.

'The bringing into operation of obsolete coal gas plant has not been without expense,' adds Mr. Crowther, 'but this was regarded as the correct step to ensure effective economies in oil consumption.' It had also made more coke available.

COUNCIL PROTEST OVER L.C.C. COKE STORE DECISION

'Nuisance' Allegation

LONDON COUNTY COUNCIL'S decision to grant temporary consent to a proposal by the North Thames Gas Board for the use of a site at the junction of Carawath and Peterborough Roads, Fulham, as a coke store has drawn a strong protest from the works and highways' committee of Fulham Council.

The Council points out in a report that the Gas Board has given the London County Council an assurance that steps will be taken to mitigate any dust nuisance.

But, it states, in view of the Council's experience of the dust nuisance from the similar use of the Gas Board's site in Bagley Lane, it is doubtful of the effectiveness of any measures which may be taken to abate any nuisance.

Gasworks Fire

Nearly 40 tons of coal had to be moved by members of Greenock Fire Brigade when they were called to an outbreak at Inchgreen gasworks, Greenock.

Part of the coal stored in a bunker had become ignited and the whole stock had to be shifted to get at the seat of the burning. While at work members of the fire brigade had to wear breathing apparatus.

Oil used by the North Thames Gas Board in December, 1956, totalled 1,972,039 gal. as against 3,467,745 gal. in the corresponding month of 1955.

DOMESTIC HEATING

Institute of Fuel Report Reviewed

THE immense effort of the Institute of Fuel in the Conference ('Special Study') of last May is rounded off by the publication of a report of the extremely interesting and lively discussions in Vol. II, 'Proceedings at the Conference.' These alone run to something like 80,000 words. It cannot be denied that, with the papers themselves, expressed in nearly half a million words, the whole presents a complete picture of the present position of domestic heating and the vast array of (sometimes conflicting) views about it. Inevitably, the shadow of the Clean Air Act was thrown across the proceedings.

It will be remembered that the Conference was organised in five sessions, in which the subject was classified under the headings: Fuels, their Sources, Production and Supply; Heating Methods and Appliances; The Design of Dwellings (from the point of view of their heating); The Planning and Administration of the Smoke Control Areas Prescribed in the Clean-Air Act; and a general summing up and discussion of the whole subject. This classification is retained in the report of the proceedings now before us. And each session was opened with a summary of the relevant papers presented by a rapporteur.

Dr. J. G. King was rapporteur for the first session, dealing with all the fuels available for domestic heating 'with the exception of oil and rich gas of the butane type.' Raw coal was also excluded, 'since an important issue in this Conference is atmospheric purity,' though Dr. King thought there might yet be a possibility of using even bituminous coal 'with a low smoke factor,' though with what advantage we cannot imagine. Summarising the efforts of the gas and coke industries to increase production of domestic coke, together with the success achieved in the carbonisation for this purpose of weakly-caking coals in normal continuous vertical retorts at 'flue temperatures below normal,' Dr. King remarked that the gas industry does not appear to visualise seriously 'the apparent possibility of using independent coal-fired producers for providing the fuel gas to heat the retorts.'

A Limit to Traditional Manufacture

The discussion in this session, as in the others, frequently overlapped the subject matter of other sessions. Speakers could not refrain from bringing in their views on methods of heating and design of dwellings. Opening the discussion, Mr. T. C. Finlayson remarked on the importance of the production of free-burning coke in the gas retort which, he said, could thus be produced 'as an adjunct to normal gas manufacture with the normal technique'—an important point in view of the fact that the gas industry carbonised over 55% of its coal in CVRs and that 'according to common report there would be a greater shortage of coking than of non-coking coals.' Dr. Burns and Mr. Moys had pointed out one way in which smokeless solid fuels could be produced with little or no increase in the cost of gas or coke.

Dr. Burns himself made a point that 'there was a limit to the amount of solid smokeless fuels which could be produced by traditional methods,' a limit set by the two factors—the amount of coal available in Groups 400 to 700, and the amount of gas which could be produced along with it, taking into account the price at which it sold. The practical application of the work done on coals of lower rank depended on the availability of, and price at which, domestic coal would be supplied to the gas industry for conversion to smokeless fuels.

There was much talk about the affection in which the open fire is still held and some mention of the heat pump. Even Mr. Hazel thought 'the highly efficient open fire was peculiarly suitable for our climate.' On this topic there was some amusing clash of opinion in the discussion on smoke control areas, session IV. Mr. Farquharson, talking of the results of a survey in Birmingham, said that a great many open grates were found to be not in use, mainly in commercial premises, in the central area. And the reason? Because the women cleaners—'Mrs. Mopps'—would not take on the job where coal had to be carried and ashes removed. Mr. Dalton called to mind Dame Vera Laughton Mathews' remark that 'in general, women do not appear to be unduly concerned over the labour of tending fires. In fact,' said Mr. Dalton, 'the housewives love it!' Mrs. Remington suggested they did it in 'self defence, hoping to maintain domestic bliss.'

Dr. Monkhouse summarised the 12 excellent papers on heating methods and appliances. His summary of the paper by L. W. Apdrews and D. R. Wills on the present position and future possibilities of gas in this field was very well done. The parallel paper of Mr. Ackery on electricity seized upon the popularity of the electric immersion water heater. As was to be expected, the discussion at this session wandered and ranged over a very wide and diverse field. Mr. W. F. B. Shaw called attention to the difficulty of assessing the cost of intermittent heating which he maintained 'was essentially a matter of heating persons rather than space.' Intermittent short period heating by a high-temperature radiant source was of great importance in such a climate as ours.

Much Good Argument

Mr. A. C. Hazel put up a good case for the free-standing fire (we can add, 'designed for using coke and fitted with gas ignition'), when, as he says, 'it is very easy to ignite and can be turned on and off like a gas-fire'; easier, one would think, turned on than off. There was much good argument at this session and it could probably be shown that a combination of gas and coke still holds the field as the cheapest arrangement. The most convenient is probably 'all-gas'—except that the electric immersion water-heater is still a formidable, in fact, unbeaten competitor in its particular line.

The cases for electric and oil space heating were strongly pressed. Off-peak electricity is a strong competitor. Floor-heating and skirting-board heating with electricity were advocated. The contributions to the discussion by Miss Griffiths and Mr. P. Draper are noteworthy. The latter pointed out that comparisons between gas and electricity are often based on a lower heat input from electricity. 'The highly radiant heat of 15,000 B.Th.U. per hr. liberated to the room by the normal medium-size (gas) fire was equivalent in output to a 4½ kW electric fire and was thus obviously more effective for quick room heating than the usual 2 kW electric unit.'

The emphasis at the session on the design of dwellings was on the importance of insulation. Mr. G. Walker said that 'apart from improvements in the design of heating appliances, perhaps the greatest single factor in fuel conservation could be provided by good thermal insulation.' Dr. J. Hamaku gave an interesting comparison between domestic fuel consumption in the Netherlands and in this country.

But it was in the final session, 'summing up and general discussion,' that we came to the highlight of the Conference—an inspiring report by the general rapporteur, Dr. Foxwell. There is much excellent material in this report. Dr. Foxwell 'advanced some propositions,' not all of them new.

Greatest Possible Efficiency

His first proposition was that 'fuel should be used for domestic heating with the highest possible degree of efficiency.' It should be possible to save 20 mill. of the 65 mill. tons of coal used for this purpose. He suggests, 'as a definite conclusion, that insulation of houses—should be examined on the economic plane from its effect on the national revenues as well as in relation to increased comfort and decreased cost to the tenant.' His second proposition was that 'there should be a re-assessment of the influence of capital investment on housing.' His third related to the installation of appliances to give good service summer and winter 'without discomfort or unnecessary labour.'

His fourth proposition was more interesting and provocative (not seriously impaired by a slight mixture of metaphor)—

Concluded on p. 299

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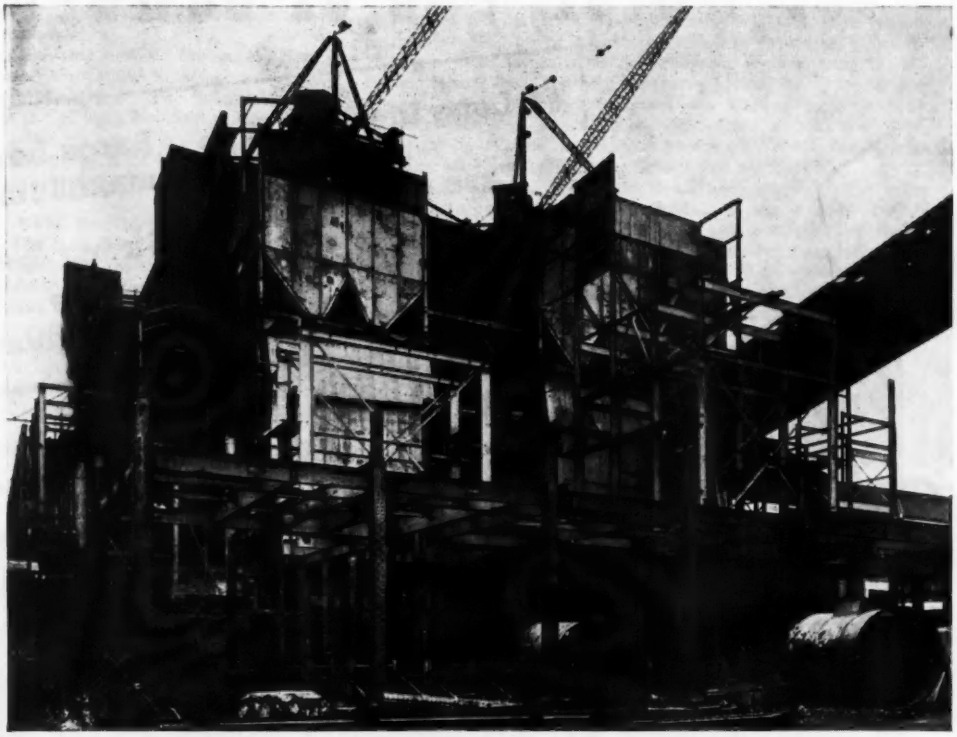

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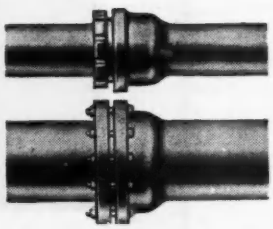

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Gas on the Continent

ABSTRACTS FROM RECENT PUBLICATIONS

The Painting of a Gasholder

M. Veillon, in an article entitled 'The Painting of a Gasholder,' writes: At Limoges a gasholder of 10,000 m³ (350,000 cu.ft.) capacity has recently been painted. This work was included in a programme to improve the aesthetic appearance of the gasworks in connection with the modernisation of the plant, both in the general lines of its architecture and in its colouring.

The two gasholders, treated in the same style, form a homogeneous assembly. The painting is a decorative camouflage. Is it a fault if the spirit of decoration prevails somewhat over the notion of camouflage?

This type of painting is difficult to realise because the gasholder, with its curved, metallic surface, presents a shining aspect which changes with the lighting, modifying the effect and presenting surprises. Often the problem is complicated by pollution of the sealing water, attacking the paint. It is to be solved by seeking a middle way; if the new work is too vivid, the action of water and dust will attack and even efface it.

The gasholder is of about 26 m³ (90 ft.) diameter and height. From the different points of view in which it can be seen it is projected wholly or partly against the sky. The base is not seen but the bracing is conspicuous.

After several projects had been studied, the painting was carried out in two colours; pale yellow and the red of old roofing, separated by a crenellated line. The bracing, painted in a very light grey, broke the effect. No doubt some would have preferred, rather than the yellow, a light grey (bluish or greenish) to resemble the sky, but it must be remembered that certain waters rapidly darken the grey and give it a deplorable aspect.

The result—a gasholder which was black is now painted in a light, agreeable colour. The base recalls the old roofs of the neighbourhood; the remainder makes no attempt to efface itself. Why should it, in this industrial environment? The colours might be criticised, but why? This quarter of Limoges, on the bank of the river Vienne, the viaduct of the Toulouse and an historic bridge, certainly justifies this essay in the æsthetic.

Standards for Combustion, Safety, Density in Gas Appliances

The steady growth in the application of gas in households has led to a search for technical standards which, to a great extent, were to be of a protective kind. To establish them is no simple matter, as they do not depend on measurements, but on factors dealing with efficiency, safety and regulations for their tests. As to safety, the main requirement is complete combustion, that is to say, that all the combustible part of the gas supplied should be consumed forming steam and carbon dioxide without leaving any poisonous residues, especially carbon monoxide. Accordingly, German standards call for such conditions that the CO content of undiluted, dry flue gas does not amount to more than 0.05% for 0.10% by volume. To obtain this result, the boiling plate has to be a ribbed plate in Germany while in other countries no such importance is attached to this, although the use of these plates together with good burners has proved to be the simplest and most effective. The same standard of 0.05% CO holds good for water heaters and gas fires. As to density, dealing with fluid gases of high calorific value under pressures up to 60-120 mm., metal gaskets at the joint between the adjusting member and the pipe line became a necessity. A further point of safety is that when, regardless of the composition of the gas, which may vary considerably at municipal works and so in combustion characteristics, the gas apparatus must be capable of adapting itself to all these conditions and provide a lively and noiseless flame. Neither should the flame produce blacking nor extinguish itself. It is evident that the fewer the variations in composition are, the simpler is the application of the safety rules. One of the principal parts in a cooking stove is the oven for baking. Here an even ignition which is clearly visible must be the rule. An igniting flame must be present before the main burner is lit. The heating of the baking oven has been studied by the Swiss and Germans. The former have introduced in their standards the "K" figure which states how many kilogram calories are required for raising the oven to and keeping it at a temperature of 210°C. for one hour. The German researches led to the establishment of the Vogel BK figure, but without its final acceptance. It is certain that neither of these figures is a criterion for the efficiency of the oven's baking capabilities. To remedy this, the Stuttgart Institute for Technical Research has introduced a system of photocells and millivoltmeters, by which the difference of browning in the baked material is shown by a comparison of figures. Another projected improvement is the indication of the oven heat by degrees instead of by numbers as is the case in many ovens.

J. Frege. *Gas-Warme*, Vol. 5, No. 9, September, 1956.

Mains Laid on River Bed

Tail gases from a refinery at Ambès, near Bordeaux, are carried across the River Garonne in mains laid in a trench in the river bed. The gases are carried in four steel pipes of 219 mm. (8.6 in.) internal diameter and 7 mm. (app. ¼ in.) thick. The pipes are arranged three side by side at the bottom, stayed together at one metre centres by steel tube distance pieces of the same section welded in and spaced at 12.50 m. apart, and the fourth placed above the centre and fixed by wire binding; timber skidding is placed under each of the three bottom pipes and timber covering on the sides of the two centre tubes. The tubes are coated with 'carboplast,' covered with glass fibre felt, and protected by longitudinal timber laths held in position by steel bands.

The trench, about 1,000 m. long and 100 m. wide (the width varying according to the angle of repose of the material —mainly gravel) of the river bed, was cut by drag-bucket dredging. The depth is such that the top tube has a cover of 3.50 metres.

The tubes were assembled on 40 wagons on a track laid at right angles to the river. One of the tubes was filled with water to weight the assembly. The 60 tonne electric winch of a dredger had its cable fixed to the end of the assembly and passing round a pulley anchored to the opposite bank. A floating crane served to manipuate the cable. Every 60 metres was a buoy with wire ropes ready to support the tubes. At each end were shear legs to take the weight.

The operation of launching was carired out without untowards incident between 6 a.m. and 4 p.m. on June 25, 1955, at a speed of 1 m./sec.; it was not necessary to suspend river traffic for more than the one tide.

This undertaking and the associated works and equipment are described by M. J. M. Lagoubie, Director-General of Gas and Electricity, Bordeaux, in the September issue of the *Journal des Usines à Gaz*.

Counteracting Pressure Drops in Long-Distance Pipe Lines

The proposed method of counteracting pressure drops consists in increasing the initial pressure from 300 mm. W.G. to 2,000 mm. W.G. (maximum 5,000 mm. W.G.) without making any alteration to the mains. As the increased pressure would be too high to work with the existing domestic meters, a regulator or governor is inserted in front of the main gas cock which reduces the pressure to normal and allows the reading of the meter as before. The advantage claimed is the maintenance of pressure over long distances, the saving in the provision of gas mains which remains unaltered and the possibility of meeting peak pressures at any given time.

A. Bignotti. *Gas*, Vol 6, No. 6, June, 1956.

From a paper to the Midland Junior Gas Association at Birmingham, January 8

Mechanisation—Some Experiences in its Application to Pipelaying and Maintenance

By B. G. HAWKINGS, M.Inst.Gas E.

DIVISIONAL DISTRIBUTION ENGINEER, WEST MIDLANDS GAS BOARD.

THOSE of us who employ direct labour almost entirely for our mains and service laying work will realise the need to increase productivity and reduce costs as much as possible, since costs are continually rising and such a large proportion of our capital expenditure is buried. With this aim in view, the distribution engineer can resort to mechanical aids and mechanical equipment which will be of great assistance in overcoming the shortage of manpower willing and able to carry out the skilled operation of underground pipelaying.

Broadly speaking, mains and service laying operations can be divided into two main categories: (a) Excavation and back-filling (including re-instatement), and (b) pipelaying and testing (including transport of materials to site). The equipment will be described and reviewed under these headings.

Constantly increasing labour costs and the fact that today men seek congenial occupations have meant that more and more civil and building engineers have turned to machines to carry out excavation generally. Of the various classes of mechanical excavators available today, all, in principle, depend on the application of a bucket or scoop, which is drawn or pushed across a face of soil or earth, but the frequency with which the operation is repeated depends on the type of excavator and the character of the soil.

Specialised Excavation

Trench excavation which is a specialised form of excavation with its limited and constant width, is effected in continuous lengths and should be more or less constant in depth, depending to some extent on the configuration of the ground surface. The depth of trench which may be dug with a mechanical excavator is limited to a great degree by the stability of the machine and is seldom greater than 12 ft., but this limitation of depth does not restrict in any marked degree its application to pipelaying projects in the gas industry. Other factors which more often limit the use of these excavators will be referred to later.

Machines for trench excavation are mainly of two types; the endless bucket chain (frequently known as trenchers) and the single bucket. Both types invariably employ back action, that is to say, the excavator bucket or buckets used for excavation are drawn across the soil face in a general direction back towards the machine. Single bucket excavators are therefore frequently referred to as 'back-actors.' Endless bucket chain excavators, or trenchers, usually consist of a central power unit, frequently a diesel engine, mounted in a chassis or frame supported on crawlers or caterpillar tracks. A power take-off from the engine through a gearbox enables an operator sitting outside the machine at the side to control its motion at several speeds.

At the rear end of the machine relative to direction of motion, a massive transverse frame assembly carries a boom around which passes longitudinally an endless chain of buckets. A separate power take-off from the engine rotates the bucket-chain on slides on the boom, through a gear-box and thence by sprocket to a chain integral with the bucket chain. Bucket speed again can be varied by the operator, through the gear-box. Set transversely across the trencher and just below the forward end of the bucket chain is a belt conveyor operated from the engine through a third power take-off which discharges excavated trench spoil at either side of the line of trench as required. The manual selector gearboxes are installed so that the speed of operation of the machine may be adjusted to suit the toughness of the ground to be excavated.

The principle of operation of this type of machine is similar to that of a bucket dredger, and consists of drawing in continuous and comparatively rapid succession steel buckets attached to the leading edge of which are hardened and toughened steel teeth to effect a tearing or ripping action across the ground to be excavated. The steel teeth are attached by bolts and can be replaced or renewed with comparative ease when breakage or wear takes place. To vary the width of trench excavated, buckets of varying width are employed, and since the buckets are bolted to the sprocket chain through plates it is usual to restrict the widths of bucket used to three or four, to allow each width to suit several sizes of pipeline. Bucket changing is therefore reduced to a minimum with a corresponding saving in standing time.

The single bucket excavator, or back-actor as it is commonly known, is built around a central power unit of diesel type, mounted in a chassis or framework supported on crawlers. There is usually a cab to house the operator and controls as well as the engine, and since the excavator bucket is carried on a special luffing jib the whole machine has a very similar appearance to a crane. Like most jib cranes the back-actor is also capable of rotating or slewing. Power for the various motions of crawling, luffing, digging, and rotating is taken through a gear box and thence by clutch drives to the various functional sections of the machine. Control of the clutch drives is effected by the driver through a set of hand levers, and the engine speed is controlled by throttle.

Towards the outer end of the jib and attached to it through a pin joint is the bucket arm, to which at its extreme end is fixed the bucket. The bucket is of general rectangular section and at its leading or digging edge are bolted toughened and hardened renewable teeth, to exert the same tearing action as with the type of excavator previously described. Set at the outer end of the jib and the bucket arm are pulley sheaves around and through which pass the steel cables, which are wound on or unwound from the power driven drums in the cab.

Principle of Operation

The principle of operation of this type of machine is to draw the bucket intermittently back across the ground towards the cab, hence the term back-actor. As with the bucket chain trencher the angle of operation of the bucket will not be the same at all phases of the operation during excavation, since the operator, after drawing the bucket towards him, completes the action by raising it with the spoil out of the trench. By this movement, the bucket has moved through an arc and is swung at the end of the jib by the operator to the side of the trench and a short distance from it where it is tipped, and the excavated spoil drops out. Jib and empty bucket are then returned to the line of trench, the bucket arm is swung and extended outward away from the cab, and the whole assembly is lowered into the trench to repeat the digging movement. While actually excavating the machine is stationary, but after a number of strokes with the bucket, it is necessary for it to be moved on from the excavated trench to enable the bucket to be drawn again into the ground forming the inclined face of the trench.

The trencher type is designed expressly for excavating or digging trenches, and it cannot be used as a face shovel (or what was once commonly known as a mechanical shovel), since it will not remove or lift soil which is above the level of the ground over which it is crawling. The back-actor on the other hand is in fact a face shovel adapted for trench excavation by reversing the bucket attachment. Although, it is in fact, a

dual purpose machine, this is of no real advantage to the engineer who is only concerned with the excavation of trenches.

On closer examination of the motions of each type of excavator, it is clear that the trencher is excavating with a continuous slow movement along the line of trench, while the back-actor is excavating only when its bucket is drawn back. The process of emptying the bucket and replacing it for the next excavating stroke, therefore, represents a period of lost excavating time. Furthermore, a greater degree of skill is necessary on the part of the driver of the back-actor than that of the trencher, since its bucket must be fairly accurately located in the trench. Added to this, more excavating time is lost each time the back-actor is moved along the line of trench to expose more ground for excavation.

A comparison of the relative speeds of operation of each type of machine under identical conditions of trenchwork, that is to say, of ground, depth, and width of trench, will show that the trencher is between 1½ and twice as fast as the back-actor. Fuel consumption with the trencher is also less, by virtue of the shorter period of wasted motion. It may well be asked why the back-actor should be used at all for trenchwork. The answer lies in the fact that it is a dual-purpose machine, and so, if not required as a face shovel, it may be more economical to employ it as a trench excavator rather than have it standing idle. This is a most important point in the economics of the mechanisation of trenchwork since idle or standing time must be avoided like the plague or at least should be permitted as little as possible. Design and its bearing on maintenance and possible breakdown periods must therefore be watched closely when purchasing a mechanical excavator.

Importance of Output

The importance of the maximum output of which any mechanical excavator is capable, must be taken into consideration when a comparison of the relative outputs and capital costs is being made between machines of differing types. Although the endless bucket chain machine or trencher is specifically designed for trenching operations, it is a fairly complex piece of equipment and does not lend itself readily to simplification. Since it is crawler mounted, it is not capable of medium road speeds and its transport from site to site invariably involves the use of a low-loader; ideally, therefore, it is a long run machine where frequent transport is not necessary. This may also be said of the crawler mounted back-actor, when transport from site to site is involved, but it is doubtful whether the back-actor is an ideal long-run machine. If it is used as a dual purpose machine it certainly would introduce a higher transport cost component into trenching costs, as well as the corresponding idle time, but if an excavator can be adapted for easy mobility, this wasteful transport component will be reduced, and it will be capable of longer excavating periods. It will be more adaptable to short-run operation and become more of a single purpose machine. Because of its digging action the back-actor lends itself more readily to axle and wheel mounting; whereas the trencher would not possess sufficient grip or reaction to digging if mounted on pneumatics. Nor can sprag or recoil stop be used as with a back-actor, because of this need for the trencher's continuous forward movement while digging.

With the increased mobility of the back-actor, it is only needed to simplify the cable winding gear to reduce the heavy maintenance and replacement costs of cables, pulleys, and linkages. In the small and medium range machines with bucket widths from 15 in. to 48 in., designers are now using hydraulic power for bucket operation instead of the usual cable gear, and mounting these machines on pneumatic tyres. This makes it possible to design the single bucket excavator round the normal agricultural tractor powered by diesel or paraffin motors, though several variations are available in which the back-actor unit is towed as a trailer, mounted on an extension of the tractor chassis or, as with some hydraulic models, mounted on truck chassis.

The tractor mounted back-actor has the advantages of complete mobility, simplicity of operation, low initial capital cost, and low running costs. To prove this it was decided to carry out an extensive trial of a machine of this type on general mainlaying work in the Warwickshire Division. The machine selected was the Bamford JCB hydraulic excavator with trenching equipment for mains from 3 in. to 18 in. diameter. It consists basically of a Fordson Major diesel tractor (of 40.3 B.H.P. at 1,600 r.p.m.) to which is attached by rigid linkages an excavator unit of very rugged construction. This is formed of boxed and braced steel channel sections, to which are attached the hydraulic cylinders and rams, and at the jib end the excavator bucket.

This J.C.B. hydraulic excavator at Coventry, which began work in December, 1954, has been employed wholly on trench excavation for housing estate mains, which is the most suitable task for a machine of this type. Any type of excavator is of little use in a built-up area where other public utility plant is buried, or for carriageway excavation, where the speed and usefulness of an excavator are reduced by the need to break up the hard surfaces encountered, though excavators are now available equipped with a compressor attachment driven from the tractor power unit. This makes it possible for air tools to be operated to break up hard surfaces or strata without the need of a separate compressor unit.

The excavator's performance has been most satisfactory in the Coventry City Area, where it has been in use for some 3,000 hours altogether and has excavated trenches for mains varying in diameter from 4 in. to 18 in. Very little rock or stone was encountered during excavations, but from time to time a particularly heavy and soggy clay had to be dealt with, requiring a special bucket with a slotted back face or alternatively the new push-plate bucket. Where there are road formations on an estate, difficulties arise due to vertical misalignment of the machine and a sleeper track has to be laid to compensate for kerb height, but very little trouble was experienced with neighbouring services being pulled out, in fact only two house water services were damaged. This may be due to the machine being operated in unturned ground, but it shows great credit for the alertness of the operator and ganger.

Generally speaking, trenches are excavated to give a final cover to the main of 2 ft. to 2 ft. 6 in. and the operator works to a line from the kerb or kerb foundations if present, or to a line of sighting rods. Excavated soil is easily deposited at either side of the trench as convenient, and when the depth of trench is sufficient, two men follow on to adjust the trench bottom for grade and acceptance of pipe joints. One of these men is always the pipe-jointer, who can ensure that the finished trench is ready for his pipelaying operations. A third man is employed when necessary to trim and clean the face of the continuous pile of excavated spoil adjacent to pedestrian paths.

Mechanically, the excavator has given little trouble, although at the beginning the hydraulic pump drive coupling showed excessive wear due to a design fault which has since been rectified. At first the balance of the machine was not too good when 'motoring' over various surfaces, including normal carriageways, with the excavating equipment in the retracted position, but a concrete ballast or balancing block carried on an extension of the chassis frame at the front of the tractor, and an extension of the frame by nine in. to 1 ft. improved stability generally. By mounting forward loaders, and compressor attachments to an excavator, however, it is possible to dispense with the concrete counterpoise.

Breakdown and Leakage

It is not clear whether the pump trouble affected the main oil supply hoses or not, but in the early stages of operation breakdown and leakage were experienced. Since replacement of these hoses is an expensive item, the manufacturers now supply repair couplings which may be inserted at a fraction of the cost of new hoses.

The performance of the bucket teeth has been good and renewals infrequent. General maintenance of the machine is carried out by the suppliers who maintain an agricultural engineering section. This service has been most valuable and is essential to the maximum ultilisation of the machine. The purchase of an excavator of this or any type is of little value unless it is backed by an adequate maintenance service. Simple greasing operations on linkages, pivots, etc., are carried out by the machine operator at regular intervals, sometimes daily. This greasing is most important both for lubrication of pivot bearings, and also to exclude from them the foreign matter which is ever present in digging operations.

The most important operation in the process of mainlaying after the actual laying and jointing of the pipes is that of backfilling and consolidation. The whole purpose of laying a pipe on a smooth regular trench bottom is to ensure that the pipe is in good contact with the trench bottom or bed throughout its length. In this way the pipe is not subjected to intense

or concentrated vertical stressing at a number of bearing points (high spots in the trench bed), but loading in the vertical plane, if applied, is evenly distributed. As most pipes are of circular section, even if they are laid on a smooth trench bed, only a very small part of the circumference will be in contact with the bed. Trench spoil, therefore, which is packed into the trench bottom around the lower half of the pipe circumference will increase the bearing surface and will help to distribute the transverse vertical loading on the pipe more evenly. This packing process is most important and can be improved considerably if, after normal hand packing and ramming, consolidation is completed by power-driven rammers.

Apart from the support given to pipes in the earlier stages of trench consolidation, a well compacted trench fill will resist further compaction by traffic and reduce trench maintenance and repairs. Normal hand ramming is of the percussive type and cannot be dispensed with when backfilling and compacting within 6 in. to 12 in. above the pipe, but over this power rammers may be used. These are of two types, percussive and vibratory.

The logical development of a machine to replace a man lifting and dropping a weight on to backfill shovelled into a trench, was for a heavy weight, the machine itself, to be thrown 8 in. to 12 in. into the air off a surface and immediately allowed to drop back on to that surface, usually backfill material. In the internal combustion driven compactor, this vertical movement is effected fundamentally by the explosions developed in a cylinder, the number of explosions per unit time being controlled by the machine operator. The machine is generally cylindrical in form, some 3 ft. 6 in. to 4 ft. in height and 9 in. to 12 in. in diameter, and the backfill material to be compacted is struck by a cylindrical foot or pestle. The total weight of the machine for trenchwork is about 250 lb.

Pneumatic Rammer

Another form of mechanical rammer which is rather more percussive than vibratory, although it possesses a component of each in operation, is the pneumatic rammer which is very similar in operation to the pneumatic road ripper. Here, too, the percussive force is applied to a flattened cylindrical foot or pestle similar in shape to the normal hand rammer. The pneumatic rammer, which is a development of the pneumatic tamper used in foundry moulding, needs a supply of compressed air so that mobile or portable air compressor is necessary for its use.

The internal combustion type of vibratory compactor is in many ways similar to the percussive type, but instead of the power stroke being transmitted directly to a spring loaded foot, a two-stroke petrol motor rotates a crankshaft assembly external to the motor, but still inside the compactor, which transmits motion to a cylindrically guided spring system. By this means vibrations or oscillations are set up and transmitted to a rectangular foot which strikes the backfill surface some 450 to 650 times per minute with very short vertical strokes of little more than an inch. The periodicity of these strokes percussive though they may be, is such as to impart a vibratory movement to the backfill material.

A machine of this type, the Wacker Vibro-Rammer, has been in use in the Coventry District of the Warwickshire Division since August, 1954, and during this time it has operated satisfactorily without general mechanical trouble. Some difficulty arose over fractures of the fuel tank brackets, due to vibration effects and the position of the fuel tank. On the machine at Coventry the brackets are bolted direct to the engine, but in the latest models the tank is supported on a tube bridge which is insulated from vibration. Later this modification will be made to the Coventry machine.

The machine is capable of compacting soils of varying degrees of heaviness, and is particularly useful on fairly wet clay. It will also tamp weak concrete where it is placed in trenches on heavy traffic routes, as well as tarmac finishing coats. Trench surfaces of whatever type, with the exception of really sloppy clay, can be finished off pleasantly and practically smooth. This is valuable on footpaths where short house entries are encountered.

Depending on the width and depth of the trench, but in the more common main sizes of 4 in. to 8 in. diameters on housing estates, the Wacker Vibro-Rammer can cope with the continuous backfilling of a trench by from three to five men. As this compactor only weighs some 110 lb. and because of its particular action, power compaction may start at an earlier stage in the backfilling of a trench, at 8 in. to 9 in. above the pipes compared to nearly 12 in. with the percussive rammer.

It is frequently necessary before excavation of the trench proper can take place, to break up the surface of the highway or ground, particularly since modern highway construction tends to favour the increased use of concrete and harder surfaces. It is also easier and faster in built-up areas, or in areas where there are other underground services, to break up the ground beneath the highway surface, too, by means of power-operated tools before starting manual trench excavation. Power-operated tools driven by compressor are usually employed.

These methods are no longer new, but the structure and design of the air compressor can often be novel, and one such item of plant is the mobile, as distinct from portable, compressor. The important distinction between these two types of compressor is that the former is completely self-contained and is essentially a mechanically-propelled vehicle, while the latter, although invariably mounted on a chassis complete with wheels, needs a towing vehicle. This distinction shows that a similar problem arises for the portable compressor as for the crawler-mounted excavator of either type. Transport from site to site—and in hilly districts even from point to point on one site—becomes of importance. The portable compressor becomes a long-run machine and the mobile compressor although available for long-runs is ideally a short-run machine.

Mobile compressors are usually of two main types; the lorry or truck-mounted compressor unit complete with a separate prime mover, petrol or diesel driven and attached direct to chassis or truck floor, and the agricultural tractor-mounted compressor in the form of an attachment, and driven through a power take-off from the tractor-drive power unit. A variant of this is the Land Rover compressor attachment, driven by the truck power-unit and mounted on the truck floor.

Comparing portable and mobile machines of the same air delivery and duty, the former possesses one big advantage—its comparatively low initial cost. This, however, is outweighed by the several advantages of the increased mobility, longer operational utility per unit of time worked and lower operational labour costs of the latter. The case for the tractor-mounted machine as a mobile compressor is strengthened when its initial cost is compared with that of the truck-mounted counterpart. Although there may be some loss of mobility with the tractor machine due to its lower road speed, it is doubtful whether this is really a serious problem since it is worth bearing in mind that the statutory road speed of the truck mounted machine *should* be 20 m.p.h.

Self-contained

The truck-mounted machine is truly self-contained and can carry its ancillary equipment in lockers or special compartments on the machine, while the tractor-mounted machine is at somewhat of a disadvantage here since ancillaries must be carried in a small trailer which may cause delay in time of emergency.

In the Warwickshire Division, based at Coventry, with the large labour force in this district, there are two mobile compressors, one of each type. The truck-mounted machine was converted at the central garage of the West Midlands Gas Board at Chester Street, Birmingham, by mounting a Broomwade SV78 petrol-driven compressor on a Fordson 8 cwt., 10 h.p. van chassis, while the tractor-mounted machine is a Holman Tractair 13. The Fordson Major (commercial model) tractor forms the basic unit of the Tractair and is available in two forms, driven either by petrol or diesel engine. The Tractair at Coventry is diesel-driven, which is to be preferred because of its lower running costs, but each type of machine develops about the same power, 28.5 B.H.P. at 75% full load, which is sufficient to deliver 110 cu.ft. of free air per minute at 100 lb. per sq. in. from the two-stage water-cooled TA.13 air compressor. This is driven by vee-belt from a power take-off shaft at the rear end of the normal road drive gearbox.

When the Tractair is driven on the highway or over the surface of the ground, the drive is taken through the normal gearbox, which forms part of the sub-frame of the tractor, and is controlled by a normal clutch pedal.

The Tractair 13 as at present designed has no lockers or receptacles, and must therefore tow a trailer in which these tools, etc., can be stowed. The small trailer of the servicelayer's type can carry all the necessary equipment, and can be towed

without invalidating in any way the special Road Fund licence for the mobile compressor, though there is still scope for development of locker capacity on the Tractair. This would reduce the capital cost of such equipment by making the extra expenditure incurred in providing a suitable trailer to carry road-breaking ancillaries unnecessary.

The operation of thrust-boring machinery as an alternative to trench excavation and backfilling is not new, although thrust-boring machinery has developed and improved since it was originally devised early in this century. In the smaller type of machines, the greatest improvement has been the use of hydraulic systems for transfer of the power applied, either manual or mechanical, to the boring head. The use of hydraulic power has simplified the boring machines in their overall construction, which has led to easier operation with more positive and successful results.

A comparison of the sub-soil of Devon and Cornwall, where the author had spent a number of years, with that of Warwickshire, indicated that it would be worthwhile to consider selective thrust-boring in the laying of services though it is fraught with dangers in a heavily developed urban area where there is other public utilities' underground plant. The most satisfactory application of thrust-boring, therefore, would be to service laying in recently developed areas, and those in course of development, though from time to time occasions may arise where a thrust-bore can be made in an older built-up area, where accurate information of underground plant exists. Thrust-bores can also be carried out beneath railway and canal embankments, as well as underneath heavily loaded major highways, but in every case a close liaison must be kept with all relevant authorities and public utilities, prior to carrying out a thrust-bore.

Reducing Capital Charges

To reduce the capital charges connected with main laying, single-sided mains are laid wherever possible. This has been made more and more possible by the fewer concrete carriageways which are being put down in a further effort to reduce housing development capital costs. Although this has reduced mainlaying costs, service laying costs may have been increased, but it is by no means certain that in all cases this increase would outweigh the decrease in mainlaying costs. Wherever possible in this area, two houses, and sometimes three are taken from a single connection to the main. When this is done each consumer's service has attached to it a small metal plate, on which are embossed the brief details of the grouped supply, for the guidance of maintenance and emergency personnel. This method of service laying can reduce costs, but in an attempt to reduce them even further, some extended trials have been made in the Warwickshire Division with the thrust-boring of the road crossings necessary with long-sided services and single mains. This would obviate excavation in the partly formed carriageways of housing estates, and the considerable care which is necessary in the re-instatement of the usual ballast and hard-core formation, the lack of which frequently causes estate developers to complain of the considerable damage caused by service crossings.

The Pass hydraulic thrust-boring machine consists essentially of a frame unit made up of duplex parallel rams, supported and tied at each end by bridge pieces or frame ends. The parallel rams are set inside duplex parallel cylinders which are in turn supported and tied near each end by bridge pieces. The cylinders are also connected internally by an oilway or port in each bridge piece. Attached to the main cylinder is a control valve or speed selector in a rectangular chest and opposite to the control valve is an oil pressure relieving switch.

In the thrust bore machine the rams are always held or strutted securely, so they do not move as with normal hydraulic machinery. Instead, the duplex cylinder assembly or 'carriage,' is traversed between the ram frame ends. In this way force is applied to the thrust-boring head and follower rods through the cylinder bridges by a special thrust collar, while stability of the rods is maintained by the centralising action of a guide collar.

Movement of the machine carriage is attained by applying hydraulic pressure between the ram and cylinder end glands. This hydraulic pressure is supplied from a manually or mechanically operated double acting plunger pump, with connections between the pump and the machine by two normal rubber pressure hoses, one of which is for high pressure and the other for the low pressure return. A gauge attached to the high pressure supply from the pump indicates directly in tons per sq. in. the thrust applied to the boring rods. On this gauge the dangerous thrust overload of 1.5 tons per sq. in. is indicated by a red limit line.

For satisfactory operation, the machine must be rigidly supported in a pit excavated as deep as possible in relation to the depth of main to which the service is to be connected. Wherever the width of the footpath and the verge permit, the machine should be located between the main and the kerb, so that the bore can be made away from the main, or alternatively the machine may be located on the far side of the carriageway and the bore made towards the main. Should either of these alternatives be possible, and there are no obstructions a bore may be made over the main to be connected from a point behind the line of the proposed boundary wall.

Trials with a Pass thrust bore machine first began in the Warwickshire Division in June, 1955, and out of a total of 61 thrust boring operations in the Coventry and Rugby Districts, 51 have been successfully completed. Bores have been carried out beneath concrete, tarmac, and partly formed carriageways, and where the building of houses on vacant spaces in municipal housing estates posed the problem of no supply main within many yards and the crossing of a concrete carriageway.

In the majority of the unsuccessful bores, failure was caused by obstructions from buried ballast or hard core which had sunk in the clay bed of the carriageway, while other failures were due to the excessive depth of the kerb base or foundations. Here the removal of excess base concrete would be necessary in any case to enable the service pipe to be laid at the correct depth and fall, without the use of a syphon near the main. So it is fair to say that the machine so far, has been over 80% successful.

Under average conditions, a bore or a normal carriageway crossing of 20 ft. can be made in from four to six hours including the insertion of the service pipe crossing, by a squad of three men. This average time is for a service pipe of 1 in. to 1¼ in. internal diameter, but for a mild steel pipeline of 2 in. internal diameter the time taken would be slightly longer. The connecting up of the service pipe to the main only takes a short time, particularly if the main has been drilled while excavation proceeded on the opposite side of the road and a flexible tee is used for the connection.

Where there are narrow footpaths, however, about 5 ft. wide, on housing estates, and they are congested, more time and patience is needed to carry out a successful thrust-bore, so that under these circumstances the value of such operations may be debated.

Future Development

An interesting future development of the use of the thrust boring machine is to draw in plastic and soft copper tubing in existing services for renewals, and new bores. If these materials, particularly plastics, are developed for gas tubing, there should be considerable scope for such a use of the machine.

In the process of mainlaying and pipeline maintenance, some form or forms of lifting and supporting tackle are needed to handle pipes and pipe specials. Such equipment may be either portable or mobile, the classic examples of which are the portable winch or shearlegs and the mobile crane.

The portable winch or shearlegs is limited in its application to the transfer of pipes, specials and large castings, from the side of the trench to the trench bed, or the suspension of these items while locating or placing them. The mobile crane, however, in addition to these tasks can also stack materials at a stacking point, remove them from this point, and to a very limited extent transport them between one point and another.

Undoubtedly, then, the mobile crane is the most useful all-round piece of handling equipment for heavy pipes and castings, but it is costly, especially in a size or capacity needed for this work.

In an attempt to obtain some of the advantages of a mobile crane without the heavy capital expenditure, attention has been given within the last few years to attachments for trucks in the form of derricks or loading platforms, which are usually hydraulically operated from the truck power unit. Early in 1956 a Bedford 5-ton long wheel base lorry was due for replacement at the mains department of the Coventry District, and it was considered that since this truck was assigned to cast iron pipe and specials transport, the replacement should be fitted with suitable attachments to extend its utility as a mains department

truck. These fitments would be tipping gear for the body, and a derrick or crane for loading and unloading, etc., both items to be operated hydraulically from a common system powered from the truck engine. The old lorry possessed a fixed body which reduced its utility in the transport and disposal of trench surplus.

In May, 1956, the replacement truck began work in Coventry District, and was fitted with tipping gear and a Lorry Loaders Ltd. 20 cwt. crane. This crane consists fundamentally of a hydraulic ram operating against a telescopic lever assembly of the third order of levers. The free or load end of the telescopic lever arm carries a crane hook with a spring loaded safety link.

The crane pillar, which contains the main ram gear, is supported by brackets bolted to the near-side main chassis member just behind the driver's cab, and is welded to the pillar. This pillar, of some 6 in. external diameter, is in two halves; a top half, which is free to slew through 180°, and a lower half which is fixed with an overlapping sleeve protecting the swivel bearing. At the base of the lower half of the pillar and below the supporting brackets is the semi-rotary slewing gear on to which a fabricated converted L, or 'boomerang' shaped bracket is welded. A pivot bearing carries the crane jib forming a fulcrum. This jib is, in effect, of straightforward luffing type.

Heart of the Assembly

The heart of the crane assembly is the hydraulic system and power for this is derived from a gearbox power take-off unit with an oil pump. When the vehicle is a tipper with hydraulic operating gear, this oil pump serves both hydraulic systems through a changeover valve. The main control valve is set in a ported cylinder mounted on a cantilever bracket welded to the bottom half of the crane pillar. As part of the control valve cylinder is the selector plate suitably notched and marked, over which the main control lever is moved to the required position, and pulled forward to apply the power. Release of the lever, which is spring-loaded, stops the movement and the load is held in the position required.

The lorry-mounted crane is not a completely mobile crane in the accepted sense, and so suffers from certain limitations. Chief among these are the inability to move with a suspended load because of the support leg and a reduced outreach under maximum load conditions. The first makes it difficult to pick up a pipe alongside a trench, move it a short distance along the trench and lower it into place. The second prevents the loading and unloading of spun cast iron pipes 18 ft. long and over 12 in. in diameter. Though they may be of suitable weight for lifting onto and off the truck, the balance point of the pipe is too far from the crane post and of the outreach of the jib.

The first disadvantage can be got over by the manual transport of the pipes on a small pipe bogey over the short distance necessary, and the crane used to load or unload the pipe bogey. A castor wheel might be developed and be embodied in the crane support to minimise this limitation. The second disadvantage, although serious in its way, does not preclude the crane operating successfully with the most commonly used pipe sizes of from 4 in. to 12 in. diameter and lengths up to 18 ft. on day-to-day district and new housing work.

The crane attachment can also be very useful for loading pipes into the parent truck at the stockyard or dump, for transport to the site, and unloading into large or small stacks. This reduces the labour force needed and obviates the need for transport of the mobile crane to the site. Furthermore, the truck mounted crane can do the journeys more quickly than the equivalent mobile crane. In isolated pipe stockyards the attendant labour may be reduced and the need for a stockyard crane cut to a minimum. This particularly applies to picking up and transporting loads which are difficult to manhandle, such as valves, specials, governors, etc.

For hydraulic equipment of this type, particularly since it is attached to a truck, it is difficult to assess operating or working costs, unless the hourly operating costs of the complete truck are considered. It would probably be fair to charge these costs to a particular job where the equipment was in use solely as a crane, as an extra to transport, but in the normal run of day-to-day work the use of the crane is a component of transport. On this basis transport costs should be reduced per ton mile or per hour by the reduction of loading and unloading times, and the additional labour left free to perform basic laying or maintenance duties should be considered.

DISCUSSION

The President, **Mr. J. A. W. Stretton** (Wrexham), opening the discussion, said it was interesting to note that the City Authorities in Paris were now insisting on the use of thrust boring for service crossings of their main thoroughfares. The type of equipment being used was known as the Virax machine and was being employed for pipe diameters of from 1¼ in. to 4 in. The President asked Mr. Hawkings whether normal lengths of pipe could be used in thrust boring operations, or whether a number of short lengths would be necessary with corresponding extra joints, which he thought might be a source of potential leakage.

Mr. Hawkings expressed his interest in the proposed procedure to be adopted in Paris and said that it would most probably be due to the traffic conditions obtaining in that city. The Virax machine was something new to him and undoubtedly, if it were a rotary machine, it would be very useful. Normal lengths of mild steel tubing were always used in thrust boring operations.

Mr. G. W. F. Cockayne (Wolverhampton), referred to the point made of the economics of organisation and how it was suggested that standing time should be avoided like the plague. That was a most important consideration and he agreed that it was quite useless to consider purchasing plant of the size and cost of an excavator unless it could be established that it could be used continuously. In the figures given by Mr. Hawkings the excavator was stated to be used 1,500 hours per annum which was only 60% of normal maximum, and he thought that that figure should be much higher to justify expenditure on so expensive a machine.

Cost figures as between manual labour and the excavator were apt to be misleading and were not high enough, particularly in regard to the maintenance component. Annual charges on such a machine were high and must be included in operating costs. Presumably, the machine had only been in use for just over two years, and maintenance costs could be expected to increase.

He did not consider that any one division would be justified in buying an excavator, because there would not be sufficient work for it to do and it would be cheaper to hire plant as required.

Dangerous Procedure

As to thrust boring, he thought that was a dangerous procedure, particularly in built-up areas where they would run the risk of inflicting damage on other services. He thought it would be better to stick to excavation by normal methods.

Mr. Hawkings said he was not surprised that comment had been made about operational time, but as he had pointed out it was hoped to improve on what had been done. The figure of 1,500 hours per annuam was an average, and he thought it could be improved upon considerably, and be increased to 1,800 or even to 2,000 hours per annum. The comparison of costs of excavation by manual and mechanically assisted methods was a basic one, since computation of overheads varied. If capital overheads were to be added to machine net operating costs, a fair comparison could only be gained by adding the overheads involved in the employment of labour such as holiday pay, sick pay, insurances, welfare charges, and so on. He thought that it was clear that on comparison the machine scored.

Mr. A. D. Mason (Birmingham) said that increasing costs were one of the great headaches in the gas industry, and it was imperative for the industry to use whatever means it could to reduce costs to the greatest possible extent. He suggested that one way was to train personnel to do jobs more efficiently, and another, to effect all economies possible. For that reason he appreciated Mr. Hawkings' approach to his subject, and he thought that in the presentation of the paper he had done a great deal in this direction. Anything that could be done in mainlaying to keep costs constant and if possible to reduce them was of the greatest value. This would be a great achievement.

Mr. R. W. Nelson (Birmingham) asked at what stage of housing development the excavator was used. Would not some form of co-ordination with other services be necessary as well as with the builders, who usually occupied footpaths, etc., with building materials? With regard to the hydraulic crane attachment on the 5-ton truck he was apprehensive of the physical strain which he thought would be applied to the

vehicle. Had such effects been observed by the author?

Mr. Hawkings replied that the excavator had been largely used on municipal estates where development was certain, and in the early stages of that development. The question of co-ordination with other services was one which was well worth consideration, and he thought that the excavator was a useful piece of equipment for the true, complete co-ordination of trenchwork. This had been done in certain parts of the country, and he would like to see a great deal more of it undertaken, but it required good will on all sides. It was obvious that there were advantages where one trench could be made and used.

No undue stressing of the 5-ton truck chassis, etc., had so far been observed as a result of the operation of the crane attachment. The folding prop or strut at the base of the crane pillar should prevent any stressing if it were correctly used.

Mr. B. M. Brock (Redditch) observed that he was aware of a vehicle with crane attachment which had suffered several chassis fractures.

Mr. A. C. Jennings (Industrial Gas Officer, W.M.G.B.), asked if the telescopic jib of the crane attachment could swing out from the retracted position when the truck was in motion. He was aware of a case where this had occurred with a crane attachment, but not of similar make, and a pedestrian, or cyclist had been struck.

Mr. Hawkings replied that this could not occur with the Lorry Loaders Ltd. attachment.

Mr. A. Griffiths (Dudley), expressed his concern that thrust boring by all public utilities appeared to be on the increase. He was concerned over the effect this might have on existing buildings and buried pipelines. Vertical boring and pile driving, which were similar operations, had shown such damaging effects in some cases. He felt rotary boring and removal of spoil to be the only alternative, and stated that he was aware that this method was being used with larger diameter pipes. He thought that co-ordinated laying of services was not too satisfactory. It needed very careful planning and co-operation at all stages, and this was frequently difficult to carry out.

Mr. Hawkings agreed with the speaker, and said that for pipelines in the larger sizes, rotary boring was the correct method. So far in the Warwickshire Division thrust boring had not been carried out for pipes larger than 2 in. nominal bore, and it was not intended that thrust bores would be made for larger diameters. With small diameter pipes, soil displacement and pressure effects were small. In any case the stresses created would not lead to collapse of cast iron pipes, but stresses had to be reckoned with which might lead to transverse loading of cast iron pipes. He had definite knowledge that co-ordinated trenchwork could lead to a reduction of pipelaying costs.

Mr. F. B. Halliwell (Leicester), emphasised that with excavating machinery, for economical working, production must be maintained. He thought that the various speeds of excavation given in the paper were too high and that the figures should be nearer 50% of those stated. Was the machine at Coventry left on site or was it returned to depôt each night, and what was an economical radius of operation if it was? Mr. Halliwell recalled that when using excavators in connection with integration mains in the East Midlands Area, the position had sometimes arisen where excavation had outstripped the capacity to keep pace with backfilling with the labour available. He was anxious to know why Mr. Hawkings had suggested that transverse mounting of the Broomwade compressor in the converted unit would have been preferable.

Mr. Hawkings agreed that excavators must be kept working, and also that normal operational speeds of excavators would be less than the maximum quoted. The speeds given were purely comparable maxima. The machine in use at Coventry was retained at the site to obviate travelling time, so that maximum digging output could be maintained. A radius of operation of four to five miles, if the machine returned daily to depôt, would be the very maximum figure. This could mean a loss of one hour of digging daily unless overtime were paid for travelling to and from depôt. Where excavation outstripped backfilling obviously compacting machinery such as the Wacker Vibro-Rammer was called for, apart from other aids such as a dozer. The suggestion of mounting the compressor unit transversely arose from the desire to keep all weight between the axles of the vehicles. The present in line mounting caused a certain amount of roll when cornering.

Reorganisation in Gaz de France

In the *Journal des Usines à Gaz* for August it was announced that Gaz de France was to be progressively regrouped in regional groups of production and transmission. The managers of each group will have responsibility for the running of the larger works and the distribution systems between them. An engineer will be specially charged with gas questions in the group and with liaison with the central technical organisation. Regional delegates will maintain liaison between the region and the director-general and they may represent him in negotiations with outside interests in the region. The original gas divisions will be superseded by the new regions as these come into being.

The first group, that of the Lower Seine, was announced in August. It was assigned to the direct exploitation of the great coke plant at Rouen, the gasworks of Havre and the network of transmission between the oil refineries and manufactured gas of this region, together with the running of gasworks at Cherbourg and Granville and the Caen system of purification, compression and transport. M. Widmer (late of Strasbourg) was nominated chief of this region with M. Maisonnier (formerly of Vierzon) as joint manager. The new organisation came into being on October 1, 1956.

In the October issue four further regions were announced: (1) The Northern Group whose zone of action extends over the departments of the North, from the Pas-de-Calais to the Somme, with M. Papillon (formerly chief of the Western Division) as chief; (2) the Group of Brittany, with Messrs. P. Bolzinger and Segoud, as chief and joint chief respectively; (3) the Group of the Loire, covering Angers and Orleans, with Messrs. Boeswillwald and Chanceaulme as chief and joint chief respectively; and (4) the Group of Lacq which will study and carry out the works necessary in the exploitation of the concessions covered by the agreement of November, 1955, between Gaz de France and the Société Nationale des Pétroles d'Aquitaine. M. Amsler (with M. Tiers as 'joint') has been nominated chief of this Group, with the additional functions of chief of the Eastern Division of Gaz de France.

DOMESTIC HEATING

—Continued from p. 292

'freedom of choice to the consumer is a horse that can be ridden to death. When it dies under us, *as it has done*, we are left stranded.' His elaboration of this theme need not be repeated here. He went on to ask, 'What more can we do?' and to discuss the personal predilections of consumers and what appliances should be installed in tenanted houses. He offered some 'recommendations'—'a combination of coke and gas need cost no more than an equal quantity of useful heat obtained from existing coal-burning appliances.' He would 'affirm that we must design future housing for a rising standard of living and that the effect of cost on the individual is usually over-emphasised—we have to prove to people that they will get a return on their money.' He then went over the ground again of the provision of the necessary fuels and the organisation and administration of smoke control areas. Altogether this report was a fitting finish to the immense amount of hard work and energetic enthusiasm which Dr. Foxwell had put into the organisation of this very successful and useful Conference.

Mr. L. W. Andrew 'accepted Dr. Foxwell's invitation to contribute written information on combinations of gas and coke' and this, accompanied by plans of a semi-detached house and a flat, is included in this volume

The report closes with some brief final reflections on the Conference by Sir Alfred Egerton. It appears to us that once again we are shown that the solution of the twin problems of smoke abatement and fuel economy in the domestic field is no longer a technological matter—it lies in the fields of psychology and sociology.

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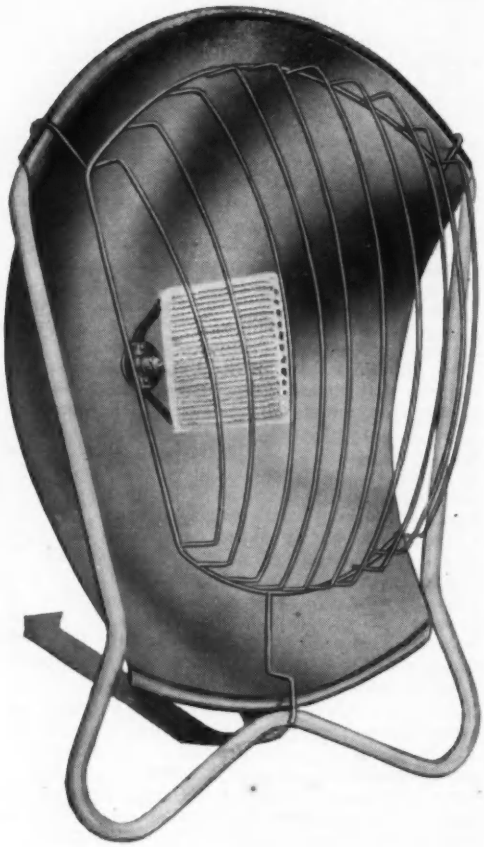

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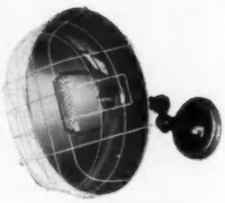

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From a paper to the London and Southern Junior Gas Association, on January 4

Application of Mathematical Techniques to Gas Research Problems

By E. WOODCOCK, M.Sc.
LONDON RESEARCH CENTRE, THE GAS COUNCIL.

EVERY expert and almost any man in the street would agree that the technology of industry is heavily dependent upon the scientific approach. This is evident if only from the incessant clamour for more scientists that issues from Government, Industry, Technical and Learned Societies. Graduate scientists and engineers are snapped up as soon as they roll off the educational production line. The Committee on Scientific Man-Power considers that the desired overall expansion of industrial output of 4% a year is only possible provided there is an adequate supply of scientists and technologists. The 1959 requirements of industry show an estimated increase over present scientific man-power of 33%.

With this expansion of science and technology, and as part of it, mathematics has developed very rapidly. As the sciences become more and more exact and highly developed, so greater demands are made on mathematical inventiveness, and the tendency to rely on mathematical techniques increases. As industry, too, becomes progressively scientific, so the creation of new mathematics and the application of mathematical techniques is stimulated and encouraged.

Before turning to mathematics, it would be an advantage to consider what is meant by the scientific approach, since this is the context in which mathematics is to be applied.

Basic Steps

The basic steps of the scientific approach may be outlined as follows. The objective of the investigation must be defined and, when the work is not academic its relation to some commercial project should be formulated, and its inter-relation with other, parallel, investigations which are proceeding with the same end in view, should be established. If it is to be a subsidiary experiment in series with some primary investigation, its relationship to the parent, needs to be stated. For pure research only, the questions which it is proposed to answer, need be set out, but in applied research the way in which the answers are to be used requires careful consideration. Preliminary experimental work is carried out, measurements made, data collected, and the literature on the subject is reviewed, since adequate access to all relevant literature is absolutely vital to the mathematician involved in the solution of an industrial problem. Mathematical insight is invaluable when reading the history of the project, and in drawing on the experiences of workers in other fields. It is relatively easy to perceive that investigations in superficially different fields often deal with the same fundamental processes as one's own, so that it is possible to incorporate the results of such work into one's own. This cannot be done with impunity as there is always a little danger in the adaptation of other people's work, though it frequently meets with remarkable success as is seen in many well known correlations in heat transfer and fluid flow theory. Generally speaking, however, failure to utilise the work of other experimenters in one's own and allied fields enormously increases the amount of work which must be done.

Hypotheses are then constructed which fit or appear to agree with the present known data. Very often they are the results of lengthy mathematical deductions from hypotheses which are compared with physical fact, and it is as well to mention here that the use of statistics is a part of scientific method. Hypotheses of a special nature are formulated, mathematical deductions are made from them and compared with the results of experiment just as in any application of science. Statistics is invaluable when comparing the mathematical theory with the results of experiment.

The hypotheses suggest what further work should be carried out, and, as this proceeds, these hypotheses are amended if necessary, until a stage is reached at which they fit both the previous and the new data, which contain the answer to the problem under study as a dependent variable. They are then elevated into a theory, which is used and tested. That is to say predictions arrived at by its use are employed in design and at the same time compared with what happens in practice. It is most unlikely that the theory will be in exact agreement with practice, but a certain measure of disagreement is tolerated and the theory stands until such time as one of three things occur:

(a) Theory and practice are unmistakably at variance under certain conditions, and the difference is so great that the risk involved in using predictions cannot be tolerated commercially.

(b) Conditions in commerce are changing with time in such a way that errors which were of no consequence have become important financially.

(c) Academic research is being carried out purely to investigate the disagreement with the object of improving the theory. When one of the above situations causes a new theory to be constructed, it often happens that the previous theory appears to be a special case of the improved one, and can only be applied in certain circumstances.

Generally speaking Nature is far too complex to be studied without some simplification of the operations involved. This is true both of experimental and theoretical work and it is usual instead, to study some model of or approximation to Nature. In mathematics this approximation to reality has become known as an abstract. It is essential to observe that the term abstract is not to be taken as meaning removed from reality, as ideal or perfect; on the contrary it is to be regarded as meaning the essence or summary of something observed in Nature. Since this technique of abstraction lies at the very heart of mathematics (and other sciences) it will be necessary to discuss the matter at some length.

Secret of its Power

This distillation of the essence from common experience is one of the principal uses of mathematics and the secret of its scientific power. Mathematics brings complex nature into focus with our near sighted comprehension, and makes possible a rational description of our experiences which accords remarkably well with observation.

When this abstraction is carried out within the narrow limits of some particular scientific or technological problem, especially but not necessarily when new approximations are required, the problem is said to be treated by applied mathematics. If this abstraction is shown to be of great utility it is seldom long before logical extension of the concepts are made, and a large mathematical edifice erected over the foundation laid by the applied mathematician. When this is so, many say that the subject becomes one of pure mathematics. It is worthy of note that a large number of the great men in mathematical history are those who might be equally well described as applied mathematicians, physicists or engineers. This is particularly true if it is realised that the best mathematics is concerned with the invention of new mathematical ideas.

When any one abstract proves to be an insufficient approximation to Nature, a new one must be found at the next highest level, and it is very often a practical man, say an engineer, who perceives that such a simple abstract does not fit the operation under study. There is, as the engineer would say, 'a discrepancy

DESIGN

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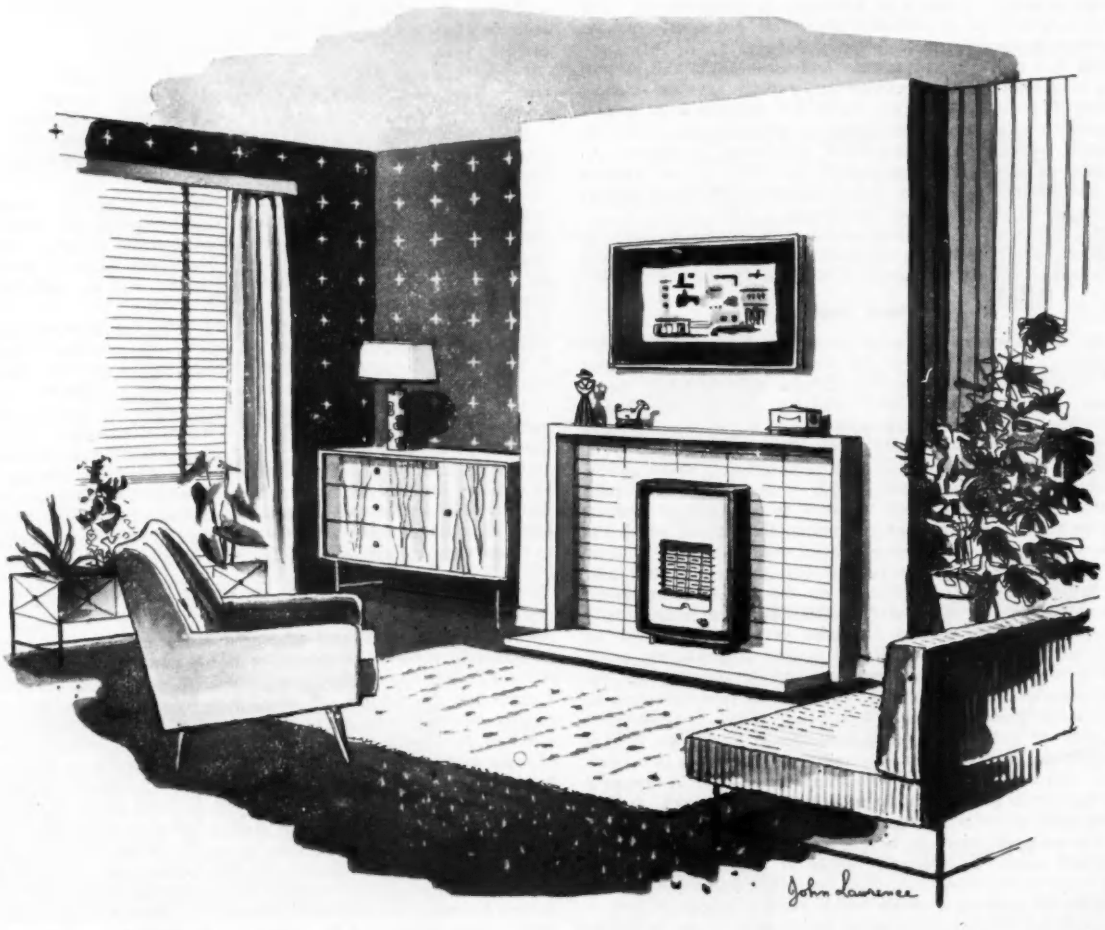

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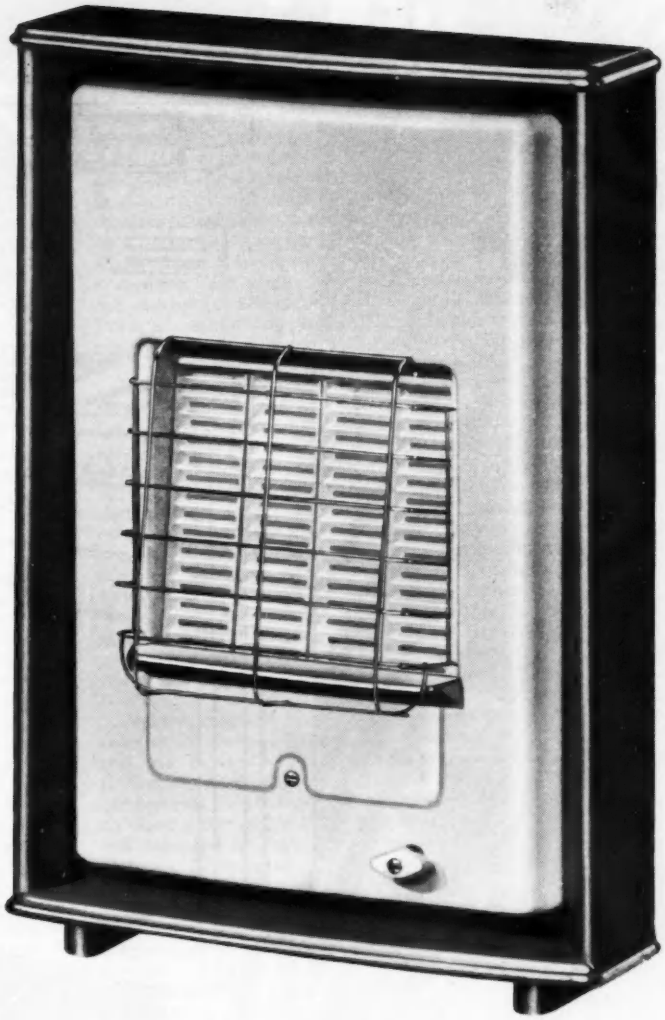
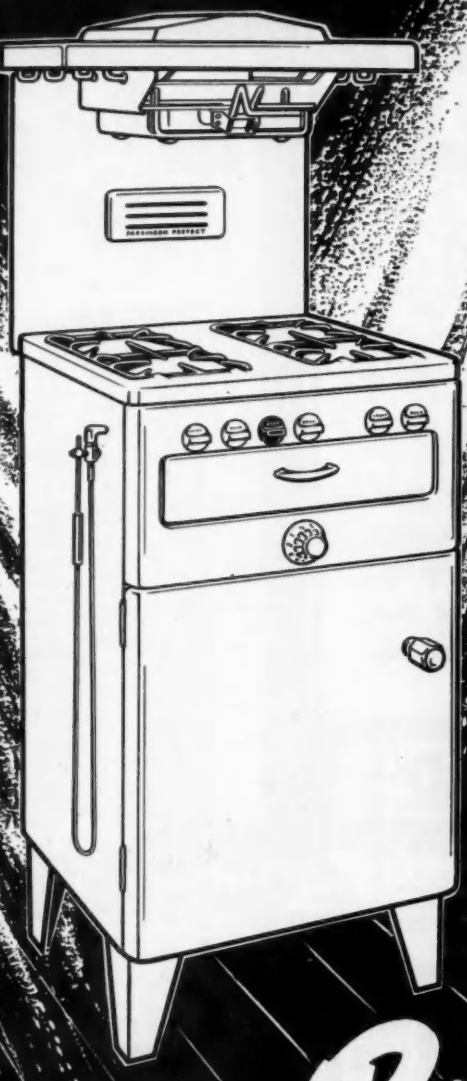


- There is no more efficient Convector Gas Fire than the RADO-VECTA
- Due to the "total head break", this efficiency is almost unaffected by wide variations in chimney pull
- New box type Rado Radiants are fitted
- The inner and outer fronts can be finished in different colours and the RADO-VECTA is available in nine attractive two-colour combinations
- Rating—16,000 B.Th.U/hr., 3-position tap, igniter and governor

Concentrate on NEW WORLD PRODUCT OF Radiation Ltd **Gas Fires**

★ANOTHER STAR



It's a **Prefect**

PARKINSON

Designed to meet the demand for a lower priced cooker with an eye level grill.
PUT IT ON YOUR FLOOR AND IN YOUR WINDOW

THE PARKINSON STOVE CO. LTD. STECHFORD, BIRMINGHAM 33
(A member of the Parkinson & Cowan Group)

between theory and practice,' which sometimes leads a few practical men to reject theory in disgust. What is really needed is the construction of a new theory at a higher level, and experience teaches us that, sooner or later, that new theory will be constructed. In this way the practical man should do all he possibly can to draw attention to discrepancies between mathematical theory and practice with the object of encouraging the development of new theory. Those who merely reject theory are the losers in the long run.

The essence of mathematics, pure or applied, is a strict deductive proof from admitted assumptions. Of course intuition, experiment, induction and plain guessing all play their part in arriving at the proof, but centuries of mathematics show that errors are least likely if the final product is arranged so that conclusions are deduced step by step from assumptions. Not only does this make for better mathematics but emphasis is thrown on the assumptions, which make it easy to decide whether they are sufficiently close to physical reality for the end product of the proof to be applied to the control of Nature. That is not to say that a strict proof must be demanded for every hesitant application of complicated mathematics to new situations. Some problems, like those in nuclear physics, are exceedingly difficult and calculations have to be made blindly, without strict mathematical justification. But as soon as possible such work must be certified by the mathematicians if coherent science is to advance.

Thrives on Criticism

Mathematics thrives on intelligent criticism and the errors of the present give rise to the glory of the future.

It is quite impossible to describe in detail all the mathematical techniques which find application in gas industry research. Those readers who require deeper knowledge will wish to consult a mathematical text book, while others would not profit from a superficial account, but the various techniques in general use are associated with three fields: Statistics, heat transfer and fluid flow. It might, however, be useful to give a short discussion of a few selected techniques which are likely to assume increasing importance in the next few years.

Dimensional analysis, which is much used in the study of heat transfer and fluid flow, is now looked upon as a branch of mathematical physics. When the differential equations have been set up for physical process one is able to arrange the variables in the form of dimensionless groups and to proceed with the consideration of a very much simplified equation. The equation could be solved in terms of the original variables, but by doing so, the understanding of the results would not be nearly so easy as the grasp afforded by a non-dimensional solution. Naturally, because the variables are non-dimensional the same numerical results apply to all physical processes simulated by the differential equation, in spite of the large range of physical values which might be associated with any one variable. Thus a non-dimensional equation in fluid flow applies to both gases and liquids. Sometimes, however, the differential equation is unknown, and in very complex cases even though capable of formulation, it is at present extremely difficult or impossible to find a solution. In such cases devices exist by means of which the non-dimensional groups may be discovered just as if the differential equation were in fact known.

Among the most useful dimensionless groups for heat transfer and fluid flow are: The Grashof (Gr), the Prandtl (Pr), and the Reynolds (Re) numbers. The Grashof number is the ratio of the buoyancy force per unit area to the viscous drag force per unit area, the Prandtl number is the ratio of the momentum diffusivity to the thermal diffusivity, and the Reynolds number is the ratio of momentum to viscous drag force per unit area.

Since dimensionless analysis arises from the very fundamentals of physics it is not to be regarded merely as a method for examining the results of experiments when all else fails, but wherever possible experiments should be conceived in terms of these groups.

Modern ideas of experimental design are for many purposes in sharp contrast to traditional ones. Early investigations in physics were directed towards the establishment of natural laws and the detailed probing of the causes of natural phenomena. To these ends, a technique was developed which demanded the holding constant of all except one of the independent variables in a physical complex, so that the effect of that one alone might be determined.

Under the influence of this classical training, such methods were carried into other spheres of activity, where in actual fact they were not at all suitable, since the data of the research worker are often subject to all sorts of chance fluctuations, and quite beyond the control of the experimenter. This precludes classical treatment and demands statistical analysis. A powerful principle is to design the experiment in such a way, that it is possible to draw valid and unequivocal interpretation of its results without referring for decision or consideration to other experiments or past experience. The interpretation of an experiment should be based wholly on its own evidence, but this demands that the whole work from beginning to end be planned in accordance with statistical principles, and in order to make the experiment self contained 'controls' are essential. Controls may be looked upon as the modern counterpart of traditional ideas. Since it is impossible to eradicate all outside influences and concentrate on one variable, such influences as are beyond our control are allowed to remain and the effect of subtraction from this minor complex of the variable or variables under consideration is determined. In one sense the new mirrors the old, and so experiments become comparative.

Those factors which are beyond the control of the experimenter constitute the experimental error. The errors do not follow any known exact laws, and so the laws of chance are usually designated as descriptive of their distribution. Some estimate of the experimental error is essential for the rigorous application of tests of significance, but before valid tests of significance can be made use of in the examination of all the information provided by an experiment, some degree of replication is required. That is to say, the experiment must be repeated on more than one series of experimental objects. Replication is the sole source of the estimate of error.

It is essential also to ensure that all replicates have the same probability of receiving in pairs either like treatment or unlike treatment. Only when randomness exists can the statistical theory of sampling distributions be applied with confidence.

Perhaps sufficient has been said to indicate that those situations which demand statistical treatment must be planned with this end in view. The common procedure of consulting a statistician after an experiment has been completed must be condemned. Unfortunately the statistician is sometimes used to cloak experiments with a scientific air. If an experimenter has managed to draw correct inferences without the use of statistics, from work which would otherwise have made a statistical design necessary, it is often a sure indication that far too many observations were made than was really necessary. The excess expenditure can be appreciable. All too often, however, when the statistician has been called in too late it only remains for him to conduct a post-mortem to show where the experiment went wrong. The technique of first carrying out work and then applying an analysis afterwards is a negation of the scientific approach. In such cases there is failure to observe that the hypotheses of classical theory, the formulation of which is the very hallmark of science, must be replaced by hypotheses of a statistical nature. An experimental design must first be decided upon before work is carried out in a field which is subject to the laws of chance and susceptible to statistical treatment.

Operational Research

Operational research may be defined as the scientific approach to decision making, and thus finds immense application in management. In business operations it is possible to construct hypotheses and to test these by experimental methods just as in any other branch of science. These hypotheses and mathematical models may, when verified, be used for prediction and control. The type of problems which can be handled by this means are in finding: The best gas tariffs, the expansion of gas production—when and by how much, the best location of showrooms, the best peak load processes, the best transport schedules, and the best appliance design.

Linear programming is a mathematical technique for achieving optimum conditions and its appropriateness is determined by positive answers to the following questions:

(1) Are you required to decide on one course of action from among several alternative courses?

(2) In making this decision, are you seeking the best of the alternatives in terms of a definite objective such as best utilisation of equipment or storage space, lowest costs, greatest profit, or some other optimum condition?

(3) Are there many factors and restrictions to consider in arriving at a decision, and are these factors interrelated? For instance, if you make W units of product A must you make X units of byproduct B? Or if you purchase Y units of product C must you also buy Z units of product D?

(4) Can you express these factors or variables that affect the problem in a quantitative way with linear functions?

Linear programming has given spectacular results on such problems as: The most profitable manufacturing programme, the best inventory strategies, the effect in changes in purchasing and selling price, the most profitable product mix, the best location of warehouses and distribution outlets, the lowest cost manufacturing schedule, the blending of petroleum fractions to produce different grades of petrol, and tar plant operation.

Linear programming may also be applied to the commercial, distribution, supplies and utilisation sides of an industry.

Naturally, commerce has hitherto got along quite well without mathematical techniques for solving these complex situations by guessing based on past experience. The more intricate the mechanisms involved, the more technicians have gathered to form a committee or study group in attempts to pool their individual raw experiences. When intuition has led to a successful solution—brilliance is recognised; when failure—bad luck has intervened—but there comes a point at which the risk based on personal opinion can be no longer tolerated financially. Even when the application of individual experience has achieved a measure of success, it is of no avail for that extra effort needed to increase productivity by 4% per annum. Here linear programming comes into its own and it is a sign of the times.

Management can be helped by linear programming to organise the facts about a problem, to seek out and analyse all possible alternative solutions to the problem, to select the best course to follow and chart specific programmes, consistent with the accuracy of the information fed in and to re-compute the programme as and when conditions change.

Desk calculating machines may be used for solving many problems, but for those of extreme difficulty only digital computers can be used and upwards of a hundred variables can be handled by these machines.

Electronic computers are being used in increasing numbers in the solution of research, engineering, accounting and statistical problems. Over 300 scientific electronic computers are now in use in America. These machines may be divided into two main classes; digital and analogue machines. Whereas digital computers operate in terms of the mathematics of a problem, say, finite differences, analogue computers function by the use of established physical systems which are analogues to the system under study. Examples of the latter are mechanical electronic analysers, nomographs, and the slide rule, but a digital computer actually solves a mathematical model, using mathematical techniques. As computers can only provide answers with the same degree of accuracy as that of the physical information fed into them they are no better than any other mathematical technique, but their great advantage lies in the ability to handle boundary conditions of immense complexity or differential equations of a high order. This would be impossible for the puny facilities of a desk calculator. Scientific problems vary in their difficulty and size so that suitable calculators must be flexible and be suitable for the solution of such problems as (1) the comparison of a theory with experimental results, (2) the provision of the design parameters for all types of systems, (3) the prediction of natural or social phenomena, and (4) the prediction of the behaviour of devices as yet unbuilt.

The Institute of Gas Technology, Chicago, have installed an Alwac high-speed digital computer, which works at speeds as great as two thousand arithmetic operations per second, and will release for experimental work skilled personnel who are now doing routine computations. The mathematical complexity of problems in fluid dynamics and thermodynamics has long impeded research in gas technology, but this computor is making it possible to solve the gas flow properties of pipeline networks such as those used in gas distribution systems and to calculate the constants for the equation of state of hydrocarbon gas mixtures which would take an impossibly long time by ordinary desk calculations.

In the gas industry at the present time mathematical techniques are being applied in the research on such problems as colour matching, food tasting, and grill design.

From a paper to the East of Scotland Junior Gas Association, Dundee, January 12, 1957

The Load Factor

By D. R. ADAMS,

DISTRIBUTION ASSISTANT, SOUTH EAST DIVISION, SCOTTISH GAS BOARD.

IT is undoubtedly true that increased sales cheapen the cost of gas into the holder, providing that sufficient manufacturing plant is available, but what is the effect of increased sales on distributing costs? If the existing mains system can handle them, all is well, but if not, we are faced with expensive mains reinforcement schemes. It also depends entirely on the nature of the new loads. If these coincide with present 'peak' output periods, when mains are already heavily taxed, then sooner or later some form of reinforcement becomes necessary.

In the layout of local distribution systems it is now standard practice to design the mains layout to a prescribed formula, in accordance with the 'peak instant demand,' which is determined by taking the output of the works over say five-minute intervals during peak periods and calculating the equivalent hourly demand. From this the maximum hourly output can be found. When due allowance has been made for large consumers, the remainder can be divided by the number of domestic consumers which gives the 'peak instant demand' per consumer. This figure can then be equated to the annual sales per domestic consumer. It is normal to design new mains with a margin for expansion of load and the following figures are usual: 15, 22½, and 30 cu.ft. per hour per consumer with equivalent annual sales of 130, 180, and 200 therms per consumer. These figures will depend on existing conditions, but it is not usual to exceed 30 cu.ft. per hour per consumer or 200 therms per annum per consumer; in fact, in many instances, a considerably lower figure may well prove adequate.

This method alone shows that new mains systems cater for peak periods while for the rest of the day and night they handle very little gas, and are consequently much underloaded.

From the definition of the load factor as the average quantity of gas distributed per hour divided by the maximum quantity of gas distributed per hour, expressed as a percentage, it is pretty clear that any increase in the maximum demand, without a similar increase in the minimum demand has an adverse effect on the load factor. To illustrate the varying loads experienced from district to district, the gas consumptions were investigated in the districts of Falkirk, Haddington, North Berwick, and Hawick, and as these represent different types of consumer predominating in the use of gas, details are given.

The town of Falkirk is the heart of the light castings industry so that a high proportion of the gas consumed there is for industrial purposes. Of the total sales domestic consumption is 52.12%, industrial is 33.81%, and commercial is 11.05%. In Falkirk the load factor is assisted somewhat by the maintenance consumption on industrial equipment but is still only 44.57%.

Haddington is the county town of East Lothian and is

situated in an agricultural area. There is a hosiery factory in the town and this accounts for the bulk of the industrial gas consumption. Of the total sales domestic consumption accounts for 65.35%, industrial for 18.80%, and commercial for 14.40%, and the load factor in this district is 38.95% which is very low.

The town of North Berwick is a holiday resort and therefore the commercial gas load forms a sizable proportion of the total output. Another feature of this type of district is that two distinct periods of high demand occur, namely summer and winter which, although improving the annual load factor, has no effect on the daily one. Of the total sales domestic consumption accounts for 58.08%, industrial for 2.23%, but the commercial has increased to 31.26%, with public lighting up to 6.48%. Here the load factor even with the abnormally high percentage of public lighting is only 45.85%.

Little Gas Used

Though the border town of Hawick is undoubtedly famous for its knitwear products, unfortunately this industry does not use large quantities of gas in its processes, but there is a fair commercial load from canteens and catering establishments. In spite of this it is a predominantly 'domestic' district. Here the analysis of sales is, domestic consumption 68.90%, industrial 11.05%, and commercial 17.78%, with public lighting down to 0.07%. A graph showing the hourly output from this works on December 13, 1956, gives a good idea of the load factor. During lunchtime, peak readings of the output were taken at 15-minute intervals. With an average of 32,000 cu.ft. per hour throughout the day, by 11 a.m. gas was being sent out at the hourly rate of 45,000 cu.ft. rising steadily to 117,000 cu.ft. by noon and dropping back to about 34,000 by 1.0 p.m. This illustrates the phenomenal 'peak' experienced in Hawick and also accentuates the extremely poor load factor of 27.10%.

Shortly after vesting day pressure conditions in Hawick were not all that could be desired and at that time a peak instant demand in the region of 15 cu.ft. per hour per consumer was being experienced. A mains reinforcement scheme was designed which would cater ultimately for a peak instant demand of 30 cu.ft. per hour per consumer. This was designed in three stages for 'peaks' of 18, 22½, and 30 cu.ft. per hour per consumer so that mainlaying could be geared to that needed to satisfy increased demands as they arose, thus limiting capital expenditure. Up to date some £24,000 has been spent on this scheme which is equivalent to 0.60d. per therm of gas sold.

On December 13, 1956, when the output checks were carried out, the figures indicated a peak instant demand per consumer of 20 cu.ft., which shows an increase of 5 cu.ft. but there has been no increase in the annual sales. This is due to the loss of the domestic gas lighting load which has been offset by the erection of 1,000 houses equipped with gas cookers and wash-boilers.

Most Alarming

In other words we have increased the sales of gas at the period of peak demand while the load factor has become very much worse. This is most alarming, because if things should continue as they are doing, we shall be back precisely where we started except that in the meantime a lot of money has been spent from which we have received no return apart from the knowledge that consumers have a satisfactory service.

Even had the domestic lighting load been retained the fact remains that the peak instant demand is increasing out of all proportion to annual sales per consumer, while, and this is due to one thing, we are securing the domestic cooking load but relatively little else. What is being experienced in Hawick applies in many other districts and it is not a healthy sign.

It is imperative that the domestic load be secured, but we must make sure that we obtain other loads also and these must be 'off peak.' The old adage 'profits are made in the retort house' is very true, but if we continue to increase the peak instant demand we might require to change the saying to 'losses are made on the district.'

The number of appliances which might add to 'off peak' demand, available in the domestic and commercial fields, is very limited so that unless an area has some type of industry consuming gas 'off peak' the prospects of an improvement in this direction are not too bright and the time has come when we must completely revise our methods of selling.

In America the companies distributing natural gas go to much trouble to maintain as high a load factor on their pipelines as is humanly possible. Appendix XXI of the report published by the British Gas Productivity Team after their visit to America in 1952 refers to methods employed in that country to deal with the load factor problem. The report states: 'Particularly during the summer, most American gas companies have developed loads on an "interruptible" or "curtailed" basis.'

In effect, the companies concerned sell gas to certain large consumers at times and seasons at which the pipelines are operating below their maximum capacity. Before such supplies are made available the gas company enters into a contract with the consumer which requires the consumer to make available suitable standby plant to take over when the supply of gas is either interrupted or curtailed. The American companies endeavour to keep supplying consumers taking gas on this basis for as long as possible, but as soon as the total gas output reaches the capacity of the pipelines these supplies are interrupted. Obviously some warning must be given to these consumers of the pending cuts but it is interesting to note that this is in fact very short. It varies from 30 minutes in the case of consumers who use gas for steam raising to 24 hours for some industrial concerns.

'Idle' Mains Must Work

I am not suggesting that we, in this country, should adopt these principles in their entirety, but I do feel that some modified version would have a lot to commend it. Our competitors in the electrical industry are already exploiting these methods. I am very well aware that our industry has the reputation for 'heat on tap,' but is there not a parallel between our mains systems and electrical generating stations? Why are the electrical authorities using this system? They, like us, have installed plant to deal with peak instant demands and have found that idle plant costs money. Is it not time that we endeavoured to make our 'idle' mains do some work?

Installations which seem capable of making a contribution to the easing of this situation would appear to be storage water heating, central heating, and a number of industrial processes such as large-scale baking, processing of special steels and iron foundries working three shifts. A new and interesting field might be found in the whole house heating load.

Distributing costs for 'off peak' loads are negligible as large enough mains have been laid to cater for 'peak demands,' so here again is a parallel with our electrical competitors and some form of reduced tariffs might be employed.

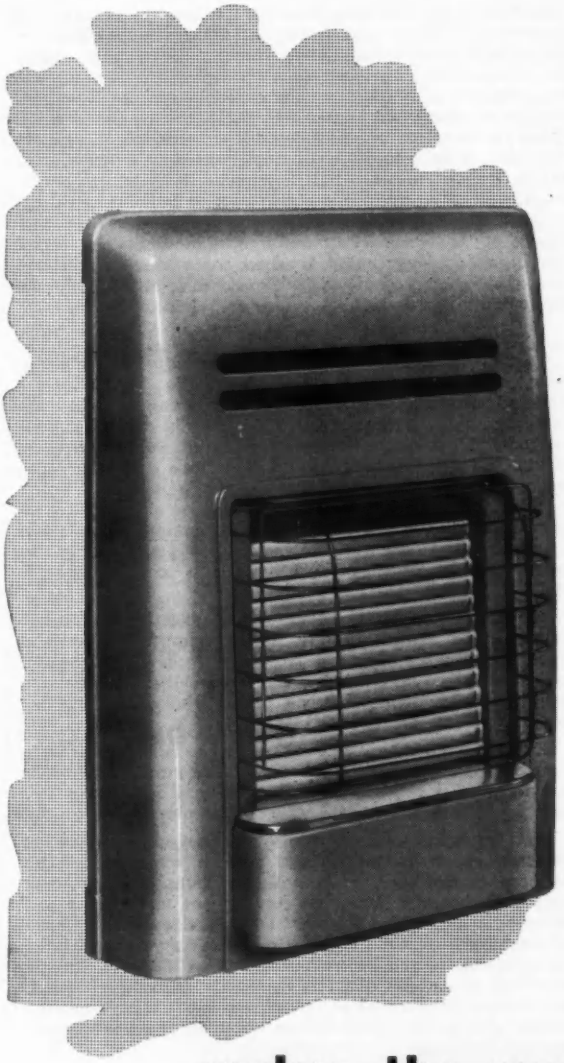
These proposals are not as revolutionary as they may at first seem, since in two districts at least something similar has been carried out. In one district central heating loads developed where the mains system was not too efficient and renewals would have made the business completely uneconomical. To overcome this it was agreed with the consumers that clock controllers should be fitted to cut out the boilers at periods of 'peak demand.' In another district, even before nationalisation, a scheme was being operated whereby gas for 'off peak' storage water heating was supplied at a reduced tariff.

REDGRAVE'S FACTORIES, TRACK AND SHOP ACTS (19th edition).

pp. 1366. Butterworth & Co. (Publishers), Ltd. Price 50s.

The last edition of Redgrave's, the 18th, was published in 1952. Over the past four years there have been quite a number of judicial decisions, and sections 12-16 and 25-26 of the 1937 Factories Act which are the most frequently considered by the courts have engaged the attention of the House of Lords. Here the validity of certain commonly advanced contentions has been pronounced. The excellent index, which was a feature of the last edition, has been made use of again and brought up to date. The table of Orders and Regulations has been improved by including a second section set out in chronological order which forms a welcome addition.

the MAIN No.55 low-cost GAS FIRE



with ★

CONVECTION HEATING

MANUFACTURER'S LIST PRICE

£11.17.7

INCLUDING PURCHASE TAX

This new Main fire combines a high standard of efficiency with attractive modern design, and its selling price is low for a convector type fire. Designed for flush fitting in a fire grate or anywhere a flue outlet is available, the No. 55 is strongly constructed, mainly of sheet steel. There is a choice of six attractive and durable colour finishes—bronze, gold, old silver, stone, eau-de-nil and sky blue. The removable fender has a polished aluminium top plate. Radiant bars to the heating unit and the fire brick are of tough refractory material; the bars are long lasting and minimise maintenance, they do not sag under continuous usage. A removable dress guard is fitted. Gas supply can be made from the right or left hand side, and a gas governor is fitted as standard. Overall dimensions of the fire are: height 26″, width 19″, depth (over dress guard) 8½″.

makes the most of each *Therm!*

★ **The No. 55 Fire's radiant heat output, achieved with a mimimum of gas consumption, is increased by about one-fifth by convected heat. The rate of circulation of hot air through the convector channel is approximately 750 cu. ft. per hour.**

Available in a variety of colours —

R. & A. MAIN LIMITED LONDON FALKIRK

Note the name-made by MAIN

F13

Main Adonis Instantaneous New

for single point or dual point use at the sink and wash basin

Here is an instantaneous water heater embodying all those features which appeal to the modern housewife — and at a price which she can afford. Simple, efficient operation; economy in use of gas; attractive contemporary design; easy-to-clean vitreous enamel finish, with a choice of colours*.

The "Adonis" can be used as a single-point, or as a small multi-point heater to serve, for example, both kitchen sink and bathroom washbasin. The "Adonis" fits flush to the wall and can be connected to standard jigged wall fittings, if desired.

Maintenance is simple — most operations can be carried out without turning off the gas and water supplies at the main.

* *The Adonis is available in Cream, White Blue or Green vitreous enamel finish*

MAIN WATER HEATERS LIMITED · CROYDON · SURREY

Note the name - made by MAIN

W68

TRADE NEWS SUPPLEMENT

RE-STYLED GAS-FIRED BOX OVENS

FOR many years the box oven has been the 'maid of all work' in industry for multi-various finishing and heat treatment processes, but it has been looked upon as a convenient rather than an efficient way of doing the job.

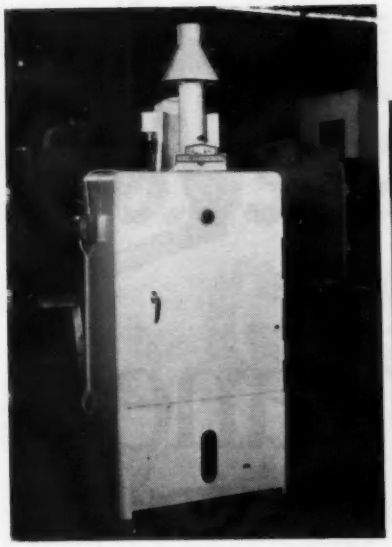
The Ballard 'New Style' range of box ovens have not only been re-styled, but incorporate many new features giving increased efficiency and improved safety standards. Particular attention has been paid to the burner equipment which is not only trouble free, but has built-in flame failure equipment, a lighting torch and a new patented gas economiser. This device is operated by a cam on the door and cuts the gas supply to the burners when the door is open. It ensures that there is no waste of gas should the door of the oven be left open inadvertently.

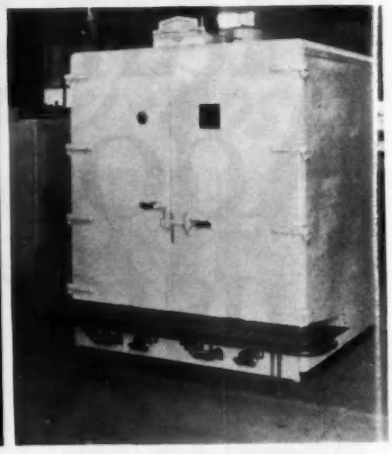
There are four types of oven to choose from and four sizes are at present readily available in each of them, giving 16 distinct models. For normal work the doubled cased natural convection oven where the products of combustion are in contact with the work has proved most popular, the treble cased oven with the products excluded from the work chamber being a second choice.

Since the introduction of fan assisted circulators to the range—with their rapid stoving times, close temperature control and improved economy—there has been an increasing call for this type, the extra initial cost being rapidly recovered by increased production and fuel saving.

Fan assisted circulation ovens incorporate an electric fan with a secondary circulating system and can be supplied either with or without the combustion products in the work chamber.

Ballard's, in recent years, have worked in close co-operation with both the Gas Council's Midland Research Station near Birmingham and the Factory Inspectorate in the design and development of safety equipment for industrial ovens. These developments have been incorporated in the 'New Style' range and are considered by the makers to be an advance on any other oven at present offered to the industry.—*F. J. Ballard and Co., Ltd., Tividale, Tipton, Staffs.*





Left: *The Ballard double-cased natural convection oven, with the products of combustion in circulation.* **Right:** *The treble-cased oven, with the products excluded from the work chamber.*

Quasi-Arc Ltd., of Bilston, Staffordshire, has issued a new technical circular dealing with manipulative equipment for manual and automatic arc welding. The circular includes a number of illustrations of some typical uses of manipulative equipment to provide efficient welding. Also included are details concerning roller beds, welding positioners, cantilevers, the Radial beam positioner, and the internal welder.

High-strength Polythene Tubes Involve Fewer Pipe Clips

FOLLOWING the successful introduction of Plastronga polythene fittings and Polyorc 'A' polythene tubing, The Yorkshire Copper Works, Ltd., have now started the manufacture of Plastronga high-strength polythene tubes made in the same material as the fittings.

Plastronga tubes in normal gauges B.S. 1972 sizes are just as strong as ordinary polythene tubes in heavy gauge sizes and can be used at the same pressures. Also, claim the company, these new tubes in normal gauges cost less than the heavy gauge ordinary polythene tubes.

Their greater rigidity and strength mean neater appearance while fewer pipe clips mean quicker and cheaper installation work. The spacing of the clips can be double the distance recommended in B.S. 1972, add the makers.

These tubes are available in 18 ft. lengths, in ½ to 2 in. normal gauge sizes, making them especially suitable for cold water plumbing services in buildings. They are also available in 50 ft., 100 ft., 200 ft. and 500 ft. coils in ½ in. and ¾ in. sizes only.

The tensile strength of Plastronga tubes is approximately 3,600 lb. per sq. in. compared with 1,400 lb. per sq. in. required of ordinary polythene tubes to B.S. 1972.

The maximum working pressures at 20°C. recommended for normal gauge B.S. 1972 sizes are shown in the table below together with a comparison with heavy gauge B.S. 1972 tubes:—

Size.	Plastronga (in thicknesses of normal gauge B.S. 1972).	Heavy gauge Polyorc 'A' to B.S. 1972
½ in.	230 lb. per sq. in.	230 lb. per sq. in.
¾ in.	200 ,, ,, ,, ,,	150 ,, ,, ,, ,,
1 in.	150 ,, ,, ,, ,,	115 ,, ,, ,, ,,
1¼ in.	130 ,, ,, ,, ,,	110 ,, ,, ,, ,,
1½ in.	120 ,, ,, ,, ,,	95 ,, ,, ,, ,,

Plastronga tubes can be flanged in the same way as Polyorc 'A' tubes for use with Plastronga polythene fittings, but more heat is needed to form the flanges.

The rigidity of the tubes does not permit the forming of acute bends while cold. The minimum radius while cold should not be less than 10 to 12 times the outside diameter of the tube, but if heated by a carefully applied blowlamp flame, bends down to a radius of six times the outside diameter of the tube can be made.

After considerable experiment and research, following the introduction of Plastronga fittings, the sizes of the fittings and flanges for ½ in. and ¾ in. normal gauge polythene tube to B.S. 1972 have now been reduced without impairing their efficiency. — *Yorkshire Copper Works, Ltd., Pontefract Road, Stourton, Leeds.*

BRINE TESTING BOOKS

The testing of brine *p*H is reduced to the simplest possible procedure with the introduction of the APV 'brine testing' book.

Each book, which is waistcoat pocket size (2 in. by 3½ in.), contains three polythene wrapped booklets of papers, covering *p*H ranges 5.2-6.7, 6.8-8.3 and 8.4-10.0. Colour reference charts within booklet covers, make the reading of *p*H values a simple and accurate task. Each brine testing book is good for at least 20 tests and costs 2s. 6d.—*The A.P.V. Co., Ltd., Manor Royal, Crawley, Sussex.*

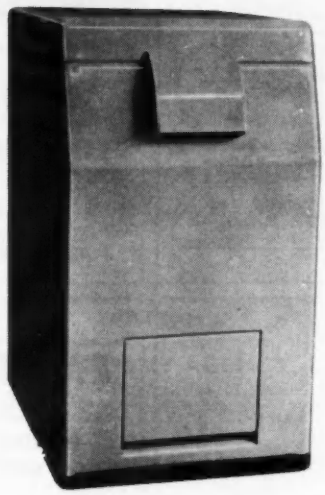
PYRENE EXTINGUISHER FOR METAL FIRES OBVIATES 'SCATTERING' DANGER

A NEW, special-purpose fire extinguisher is now being marketed to meet the exceptionally difficult problems associated with fire outbreaks involving metals such as sodium and calcium, or magnesium and aluminium in the form of powder or swarf.

Manufactured by The Pyrene Co., Ltd., the new extinguisher, Model PDMU 25, is charged with 25 lb. of dry chemical powder which is discharged under pressure provided by a cartridge of CO_2 gas. The dry chemical powder is applied to the burning metal by means of a specially-designed applicator comprising a long tubular metal extension terminating in a cone-shaped spreader. The applicator ensures that the discharge of dry chemical powder is delivered lightly on to the fire in order to prevent the danger of scattering which is associated with this class of fire.

Speedy operation is effected simply by removing the safety clip, detaching the applicator and striking the top of the extinguisher. A 'squeeze-grip' control valve enables the flow of dry chemical powder to be shut off at will and to be used to its fullest advantage.

Full details of the new extinguisher are contained in an illustrated leaflet which may be obtained from:—*The Pyrene Co., Ltd., 9, Grosvenor Gardens, London, S.W.1.*



The 1957 version of the Kayenco 'Superb' gas-fired boiler, model S.70, which was being shown with its redesigned appearance at the Gas at Work in Industry Exhibition. The boiler has a rated output of 70,000 B.Th.U. per hour and is suitable for bulk supplies of hot water or heating large premises such as offices.— *Frederick Kay (Engineering) Ltd. Nashleigh Works, Chesham, Bucks.*

Donald MacPherson & Co., Ltd., have recently opened their new Nottingham depôt at : 178, Sherwood Street North, Nottingham (Telephone 42930).

A full range of 'Foochow' decorative materials will be stocked and, whenever required, stocks of industrial finishes will also be held.

Plastic Dough for Lagging

SAVING UP TO 80%

THE first lagging material capable of being applied as a dough speedily and easily by unskilled people has made its appearance on the market. The use of Dohmlag plastic dough for lagging has saved, according to fuel efficiency experts, as much as £2,000 per year in a comparatively small-sized factory of approximately 15,000 sq. ft. by cutting out wasted heat, claim the makers. Its saving over unlagged pipes is up to 80%.

Dohmlag is said to keep frost out as effectively as it keeps heat in. The material, which is supplied in powder form, is mixed to a dough by adding water, whether it is to be employed for hot or cold pipes.

Hot water equipment, after a thorough surface clean, must be kept warm during application. Small patches of the material are then dabbed on to provide an 'under-coat' and when dry the final coating, 1 in. thick, is applied by hand and finally smoothed off with a trowel or knife.

Cold water pipes require a thin layer covering the whole surface as an undercoat, but in all other respects the treatment is identical, although they take longer to dry in winter. It is advised that cold water pipes should be lagged in the warmer months to enable complete drying by the time the frosts occur.—*Dohm, Ltd., Victoria Street, London, S.W.*

Filmstrip Describes Meter Installation

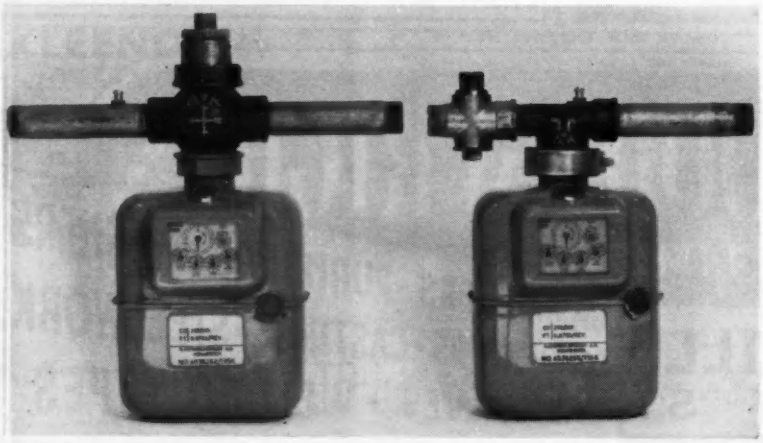
A STANDARD filmstrip has been prepared for the projection of 34 illustrations of meters and their installation, with special reference to the one-pipe principle invented and pioneered by G. Kromschröder A.G.

Two of the many possible applications of the one-pipe principle are illustrated.

On the right of the picture is an ordinary consumer's control with coaxial tee and pressure test point, in the gas pipeline. A one-pipe meter is connected by one union nut, with sealing ring against unauthorised interference.

On the left is a coaxial cross in the gas pipeline. Gas goes to a consumer's coaxial control at the top of the cross, thence to the one-pipe meter below, and thence to the installation pipe on which is a pressure test point.

In either case, the inlet may be from any direction and the union nuts may be secured against interference either by wires (through holes provided) and seals, or by sealing rings and seals.



The meters shown have been stamped in accordance with the Gas Act, 1948, Approval (Meters) No. 81. There is not, and never has been, any intention to import meters for general sale; but only to ensure that meters of the original design (proved in other countries) should be readily available for district and other tests to establish the suitability of the one-pipe principle for British conditions and for one-pipe gas meters to be made in Great Britain. —Tekon, 50, Baker Street, London, W.1.

AGENTS FOR MARCO

Marco Conveyor & Engineering Co., Ltd., have appointed Andrew McNair & Co., of 261, West George Street, Glasgow, C.2, as their sole agents in Scotland.

THOMAS BUGDEN & CO.

India-Rubber and Airproof Manufacturers and General Contractors.
LARGEST MANUFACTURERS OF GAS MAIN BAGS.
Telegrams—"AIRPROOF, BARB, LONDON." Telephone—6147 CLERKENWELL

Contractors to H.M. Government

Gas Bags for Repairing Mains

PATENTEES OF THE
DENMAR BAG
Impervious to Main Liquor and Climatic Influences.

Round or Cylinder Shape.

Pull-through and Expanding MAIN STOPPERS.

All types of INDIA-RUBBER BOOTS.

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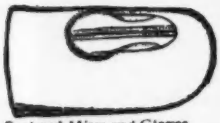
HOSE AND TUBING FOR ALL PURPOSES.



Stokers' Mitts and Gloves of every description.

Contractors' & Miners' Woollen Jackets, Trousers, Hats, &c.

244, Goswell Road, LONDON, E.C.1.

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ULTRASORB Carbons are available for recovery of most industrial solvents, benzole extraction, water purification and other gas and liquid phase applications.

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Grams: 'Bricarbun Grays' Tel.: Grays Thurrock 4845

CARBO - UNION - WHESSOE

Activated Carbon Recovery Plant for the purification of gases and the recovery of vapour phase solvents.

Whessoe Ltd : Darlington : Co. Durham
Cables: Whessoe Darlington Tel.: Darlington 5315
LONDON OFFICE:
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Systematic repairs to structures based on systematic diagnosis of defects

WHITLEY MORAN & CO. LTD

Specialists in the Repair of Engineering Structures
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GAS METER CRANKS
Telephone: DUNSTABLE 90
The Clifford Engineering Co., Ltd.
Dunstable, Beds.
Specialists for over 35 years
Single and double throw cranks for all meters

EWART CHAINBELT CO., LTD.

DERBY, ENGLAND

Driving and Conveyor Chains of the best quality; made of Ley's Celebrated Blackheart Malleable Iron.

ALSO COMPLETE CONVEYORS AND ELEVATORS

HAIR FELT SHEETS,
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GEORGE E. SAWYER LTD. 35/36 ASTON STREET, BIRMINGHAM, 4
Phone.: ASTON Cross 1163 & 2642 Grams.: "Accomplish"

CASES FOR BINDING

Quarterly Volumes of the 'Gas Journal'

7/6 each, post free

Walter King, Ltd., 11, Bolt Court, Fleet Street, London, E.C.4.

WESTWOOD & WRIGHTS LIMITED

BRIERLEY HILL, STAFFS.

GASHOLDERS · PURIFIERS · WASHERS
CONDENSERS · CASTINGS · STEELWORK
GAS VALVES · WELDED PIPES

PUBLISHERS' NOTICE

The " Gas Journal " is published every Wednesday, price 1/6d.; by post 1/8d.

Subscription Rates:—65/- per annum; (Payable in advance.) A copy of the " Gas Journal " Calendar & Directory is presented each year to continuous subscribers.

Classified Advertisements: All small classified advertisements are charged at 2/6 per line (approx. 7 words)—minimum charge 10/-. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received 14 days prior to publication if proofs are required. Type area of inside pages 10 in. deep × 7 in. wide; block screen 120.

BUSINESS MANAGER: S. T. CULLEN

NORTHERN MANAGER: Philip W. B. King, Flat 1, 7 Langcliffe Avenue, Harrogate. *Telephone:* Harrogate 67625.

SOUTHERN & MIDLANDS REPRESENTATIVE: A. Engelhardt, T.D., 11, Bolt Court, Fleet Street, E.C.4. *Telephone:* Fleet Street 2236-7.

WALTER KING, LTD., 11, Bolt Court, Fleet Street, London, E.C.4.

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SPECIALLY ACTIVATED OXIDE OF IRON

Oxide supplied on loan or sale outright.
Highest prices paid for Spent Oxide.

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NU-SWIFT?

Details, please, of Nu-Swift rapid and reliable Fire Extinguishers—BEFORE IT IS TOO LATE!

Name.....

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Post NOW to Nu-Swift Ltd., Elland, Yorkshire

In Every Ship of the Royal Navy

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For sale to the public and in bulk for works use

SALE & CHURCH, LTD.

CROMPTON WAY, CRAWLEY, SUSSEX

PATENTS

KINGS PATENT AGENCY, LTD.

(Director, B. T. King, A.I.M.E., Patent Agent) Advice, Handbook, and Consultations free. 146a, Queen Victoria Street, London, E.C.4. 'Phone: City 6161.

PLANT FOR SALE

FOR SALE.—One unused 48 in. all C.I. Sluice Valve by Glenfield. Flanges 55¾ in. diameter, 28 holes, 53¼ in. P.C.D., 2 ft. 3¼ in. long. Cleckheaton Engineering Co. Ltd., Cleckheaton, Yorks. Phone 397.

SPECIAL OFFER: Large quantity of new cast iron fullway valves, all iron parts, 8 in., 10 in., 12 in. and 14 in. for sale. The Midland Iron & Hardware Co. (Cradley Heath) Ltd., Cradley Heath, Staffs. Tel.: Cradley Heath 6264 and 5.

APPOINTMENTS VACANT

THE SOUTH WESTERN GAS BOARD requires a FITTER-IN-CHARGE at Somerton. The rate for the job is 4s. 8½d. per hour. An attractive flat is available on a Service Occupancy Agreement at a reasonable charge.

Applicants should possess a First Class Gasfitting Certificate and have had at least five years' experience on appliance and service installations and maintenance.

Applications should be addressed to the District Manager, South Western Gas Board, 33, Middle Street, Yeovil.

NORTH EASTERN GAS BOARD

DISPLAY & EXHIBITION DESIGNER

THE North Eastern Gas Board invite applications from persons with good design qualifications and practical experience for the above position at the Board's Display Centre at Drighlington (6 miles from Leeds). The work undertaken by the Centre, which possesses a small Studio and Workshop, embraces the design and making up of display units and silkscreen display material for the Board's showrooms and also the design and building, etc., of exhibition stands. The person appointed will be in charge of the section and will work under the direction of the Board's Publicity Officer.

The commencing salary will be determined according to qualifications within either Grade A.P.T. 7 (£670-£750 per annum) or A.P.T. 8 (£710-£790 per annum) of the Salary Scales agreed by the National Joint Council for Gas Staffs.

The successful applicant will be required to pass a medical examination and to join the Board's Staff Pension Scheme.

Applications giving full details should reach the Chief Commercial Officer, North Eastern Gas Board, Head Office, Bridge Street, Leeds, 2, by February 23, 1957.

NORTH WESTERN GAS BOARD

BOLLINGTON DEVELOPMENT STATION
TECHNICAL ASSISTANTS (PRODUCTION)—

APPLICATIONS are invited for the above two pensionable appointments at the Board's Development Station, Bollington, nr. Macclesfield, Cheshire, at salaries within Grade A.P.T. 10 (£820/£920 p.a.).

The work is of a varied and interesting nature and at present is concerned predominantly with the production of briquetted smokeless fuel.

Applicants should be qualified in chemistry, or gas or chemical engineering, either by Corporate Membership of a recognised professional institution or by holding a British university degree.

They should also have had experience of operating gas or chemical plant and be prepared to undertake shift work.

Detailed applications, giving the names of two referees, should reach the Secretary, N.W.G.B., 60, Whitworth Street, Manchester, 1, within 14 days.

NORTHERN GAS BOARD

DARLINGTON DIVISION

APPLICATIONS are invited for the following appointments:—

DIVISIONAL CHIEF ENGINEERING ASSISTANT

The minimum grading for this post is Provincial 'A' Grade A.P.T. 10 (£820-£920), but the Board reserve the right to place the occupant, either at the time of appointment or later, in Grade A.P.T. 11 (£850-£975) should his qualifications, experience or performance of the duties of the post merit such higher grading.

Corporate Membership of the Institution of Gas Engineers or an equivalent qualification in Engineering is essential.

Duties include the preparation of plans, specifications, maintenance and control of Engineering & Constructional projects within the Division.

TECHNICAL ASSISTANT (MECHANICAL)

The minimum grading for this post is Provincial 'A' Grade A.P.T. 7 (£670-£750), but the Board reserve the right to place the occupant, either at the time of appointment, or later, in Grade A.P.T. 8 (£710-£790) should his qualifications, experience or performance of the duties of the post merit such higher grading.

Duties include the maintenance of plant, machinery and buildings at the Darlington Unit, and candidates should possess the Higher National Certificate in Mechanical Engineering or equivalent qualification.

TECHNICAL ASSISTANT (PRODUCTION)

The minimum grading for this post is Provincial 'A' Grade A.P.T. 5 (£575-£655), but the Board reserve the right to place the occupant, either at the time of appointment, or later, in Grade A.P.T. 6 (£610-£690) or Grade A.P.T. 7 (£670-£750) should his qualifications, experience or performance of the duties of the post merit such higher grading.

Candidates should be conversant with the operation of Continuous Vertical Retorts, Carburetted Water Gas Plant and Ancillary Plant.

Applicants should have completed their National Service. The posts are pensionable and successful candidates will be required to pass medical examinations.

Applications, stating age, qualifications and experience, together with the names of two referees should be received by the undersigned not later than February 25, 1957.

F. WILSON,
Divisional General Manager.

Gas Offices,
John Street,
Darlington.

(*Classified advertisements continued on page* 314)

APPOINTMENTS VACANT (ctd.)

WEST MIDLANDS GAS BOARD

WALSALL & DISTRICT DIVISION
DISTRICT SERVICE MANAGER, LICHFIELD

THE successful applicant will be responsible for supervising the operation of the Sales and Service Department in a District with approximately 3,600 consumers. The duties will also include responsibility for routine maintenance of the Distribution system and local clerical records Candidates should be experienced in the installation and maintenance of all types of gas appliances and the control of personnel, and should possess a knowledge of mains and service laying, particularly emergency work.

The salary will be within the range of A.P.T. Grade 7 (£670-£750 p.a.) of the National Salary Scales.

The service tenancy of a flat will be available at a reasonable rental.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to Mr. F. Harvey, Divisional General Manager, West Midlands Gas Board, Walsall Factory Estate, Tame Bridge, West Bromwich Road, Walsall, to reach him not later than February 18, 1957.

J. C. INGRAM,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

TECHNICAL ASSISTANTS (PRODUCTION)—
BIRMINGHAM AND DISTRICT DIVISION
WORKS SUPERINTENDENT—SOLIHULL

CANDIDATES should possess retort house experience and have a sound working knowledge of wet and dry purification, exhausting, boosting, gas storage, and general works routine. Experience in controlling labour is essential and the possession of a technical qualification such as a Certificate in the Technology of Gas Manufacture, or its equivalent, will be an advantage.

The Works produces base load coal gas from C.V.R.'s and will shortly have a capacity of 3½ mill. cu.ft. per day. The person appointed will be responsible to the Engineer and Works Manager, or his Deputy, and must be able to take charge of the works in their absence.

The salary will be within A.P.T. Grade 8 of the National Salary Scales for Gas Staffs (£710-£790 per annum).

The post is pensionable and the successful candidate may be required to pass a medical examination.

A pleasant house, in which the successful candidate must reside, is available on the Works at a reasonable rent.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to Mr. J. E. Wakeford, Divisional General Manager, West Midlands Gas Board, Gas Offices, Edmund Street, Birmingham, 3, to reach him by not later than February 18, 1957.

J. C. INGRAM,
Secretary to the Board.

WALES GAS BOARD

NEATH UNDERTAKING
ASSISTANT ENGINEER AND MANAGER

APPLICATIONS are invited for the appointment of ASSISTANT ENGINEER and MANAGER to the Neath Undertaking.

Neath Undertaking is supplied with Coke Oven gas from the Board's Grid system and may be called upon to manufacture peak load C.W.G. Applicants must have a sound knowledge of modern Distribution practice; knowledge of large scale industrial utilisation would be an advantage.

Applicants must be Chartered Gas Engineers, possess appropriate Technical qualifications and have experience of the Administration of a Gas Undertaking.

The commencing salary, according to experience and qualifications, will be in accordance with Grade A.P.T. 12A (£900-£1,025 per annum). The post is pensionable and the successful applicant will be required to pass a medical examination and to subscribe to the Board's Superannuation Scheme.

Applications giving details of age, qualifications, experience and present position together with the names of two referees should reach the undersigned not later than February 18, 1957.

G. FITTON,
Engineer and Manager.

Gas Works,
Millands,
Neath,
Glam.

WALES GAS BOARD

SWANSEA UNDERTAKING
TECHNICAL ASSISTANT (DISTRIBUTION)

APPLICATIONS are invited from suitably qualified and/or experienced persons for the abovementioned vacancy.

Applicants should be experienced in the preparation of specifications, drawings and estimates for distribution work; experience in the control of labour and in the supervision of work being carried out by Contractors would be an advantage; the district is a rapidly expanding one both in industrial and domestic consumers numbering 40,000 at the present time.

Salary will be in accordance with Grade A.P.T. 6 (Provincial A) of the National Salary Scales (£610-£690) commencing at a figure commensurate with qualifications and experience.

The post is pensionable and the successful applicant will be required to pass a medical examination.

Applications, stating age, training, experience and qualifications, accompanied by names of two persons to whom reference can be made, should reach the undersigned not later than Friday, February 22, 1957.

A. PICKARD, M.Inst.Gas E., M.I.I.A.,
General Manager and Engineer.

Gas Offices,
Oystermouth Road,
Swansea.

WALES GAS BOARD

SWANSEA UNDERTAKING
APPOINTMENT OF SENIOR TECHNICAL ASSISTANT (DISTRIBUTION)

APPLICATIONS are invited from suitably qualified persons for the above appointment for which the salary will be within the range of Grade A.P.T. 7/8 'A'—£670-£790 per annum commencing at a figure commensurate with qualifications and experience.

A house with garage will be available at a reasonable rental, if required.

The district is a rapidly expanding one both in industrial and domestic consumers numbering 40,000 at the present time.

Applicants should be experienced in Modern High/Low Pressure Gas Distribution Practice, including mainlaying and planning and in the control of Distribution personnel.

The position is pensionable, subject to satisfactory medical examination.

Applications stating age, experience, professional qualifications and particulars of training, together with the names of two referees, should be received by the undersigned not later than Friday, February 22, 1957.

A. PICKARD, M.Inst.Gas E., M.I.I.A.,
General Manager and Engineer.

Gas Offices,
Oystermouth Road,
Swansea.

SHIFT SUPERVISORS required for Coal Carbonisation and By-Product Recovery Plant near Chesterfield. Applicants should have experience of control of all types of labour and knowledge of steam raising and gas producer plants. Previous experience on similar Works an advantage. Concessionary fuel allowance is given. Write in first instance giving particulars of age, experience and salary expected, to No. 312, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

COLONIAL GAS HOLDINGS LIMITED
MELBOURNE, AUSTRALIA

APPLICATIONS are called for the following appointments:—

MANAGER

Manager of a Melbourne suburban gas undertaking with an annual output of approximately 1,200 million cubic feet of 500 B.T.U. gas manufactured in Glover West continuous vertical retorts.

Duties.—To be responsible under the direction of the General Manager, for the control of the Works and District of the undertaking.

Salary. — £2,000-£2,500 Australian currency, depending upon experience and qualifications.

A car will be provided for use on company's business.

WORKS SUPERINTENDENT FOR SAME UNDERTAKING

Duties.—Under the direction of the Manager, to be responsible for all gasworks' operations.

Salary. — £1,700-£1,800 Australian currency, depending upon experience and qualifications.

In each case, the company will pay one-class steamer fares (P. & O. or Orient Line) to Melbourne for appointee and his family, and also transport personal effects. Salary will commence from date of embarkation. If required, assistance will be given with securing of suitable housing in Melbourne.

Applications should be submitted by March 4, addressed to The Colonial Gas Association Ltd., care William Coward & Co. Ltd., 3, St James's Square, London, S.W.1.

NATIONAL COAL BOARD

EAST MIDLANDS DIVISION, CARBONISATION DEPARTMENT

A VACANCY exists for a SCIENTIST Grade (£925 × £35—£1,300) to take charge of the Avenue Carbonisation and Chemical Plant Laboratory which has a staff of 30 chemists. Candidates should possess Hons. B.Sc. or A.R.I.C. or equivalent qualifications and should have had experience in Carbonisation and the testing of benzole and tar products.

Applications should be sent to the Administrative Officer, P.O. Box 16, Chesterfield, to arrive not later than February 23, 1957.

NORTH THAMES GAS BOARD

SHIFT SUPERINTENDENTS are required for various of the Board's manufacturing stations.

Applicants should have a sound knowledge of and experience in, the control of coal gas and carburetted water gas manufacturing processes. Ability to take responsibility is essential. Successful candidates will be required to work a 48 hour week and to join the North Thames Gas Board Staff Pension Scheme.

Starting salary will be within the range of £7(illegible) to £885 per annum depending on age, qualifications and experience.

Applications, giving full particulars, should be sent to the Staff Controller, North Thames Gas Board, 30, Kensington Church Street, W.8, quoting reference 666/423.

SOUTHERN GAS BOARD

SENIOR DRAUGHTSMAN—MAINS

APPLICATIONS are invited from suitably qualified persons for the new post of Senior Draughtsman (Mains) in the Central Drawing Office at Area Headquarters, Southampton.

Applicants should preferably hold the Higher Grade Certificate in Gas Supply or equivalent qualification and must have had sound experience or knowledge of district plant and mains work.

The appointment will be made within Grade A.P.T. 10-12 (£820-£1,025) of the National Salary Scales for Gas Staffs, and the starting salary will be dependent upon the qualifications and experience of the successful applicant.

The successful candidate may be required to pass a medical examination and, unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required to join the Board's Staff Pension Scheme.

Applications, headed 'Senior Draughtsman (Mains)' and stating age, education, experience, and present appointment should be addressed to reach the Personnel Manager, Southern Gas Board, 164, Above Bar, Southampton, not later than March 2, 1957.

SOUTHERN GAS BOARD

DRAUGHTSMEN

APPLICATIONS are invited from suitable qualified persons for four new posts of DRAUGHTSMEN in the Central Drawing Office, at Area Headquarters, Southampton.

Applicants should preferably possess the Higher National Certificate in Mechanical, Electrical or Civil Engineering, the Building Certificate or equivalent qualification, and should have experience or a knowledge of gasworks plant, and/or district plant and mains layouts.

The appointments will be made within Grade A.P.T. 6-9 (£610-£855 per annum) of the National Salary Scales for Gas Staffs, and the starting salary will be dependent upon the qualifications and experience of the successful applicants.

The successful candidates may be required to pass a medical examination and, unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required to join the Board's Staff Pension Scheme.

Applications, headed "Draughtsmen," and stating age, education, experience and present appointment should be addressed to reach the Personnel Manager, Southern Gas Board, 164, Above Bar, Southampton, not later than March 2, 1957

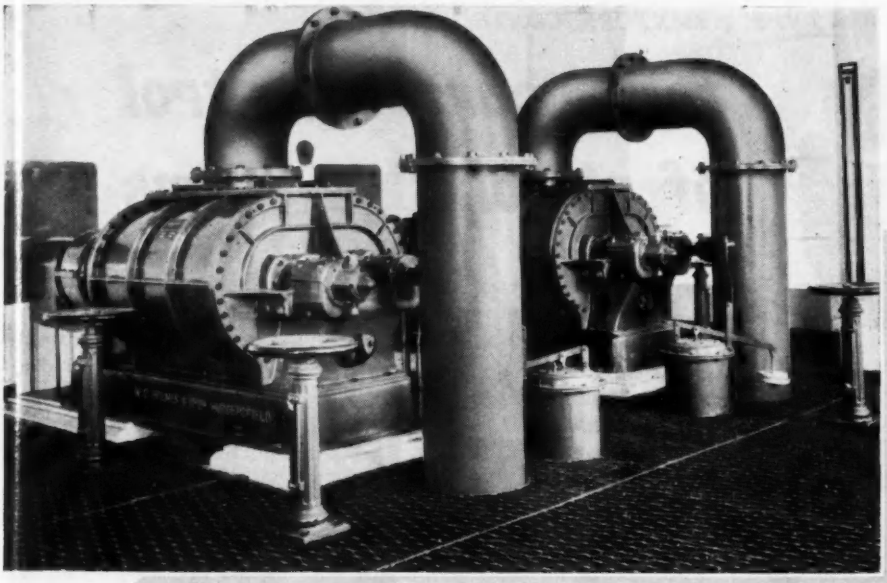
DOMESTIC UTILISATION OF GAS

SMITH & LE FEVRE

20/- *inc. postage*

WALTER KING, LTD.

11, Bolt Court, Fleet Street,
E.C.4.



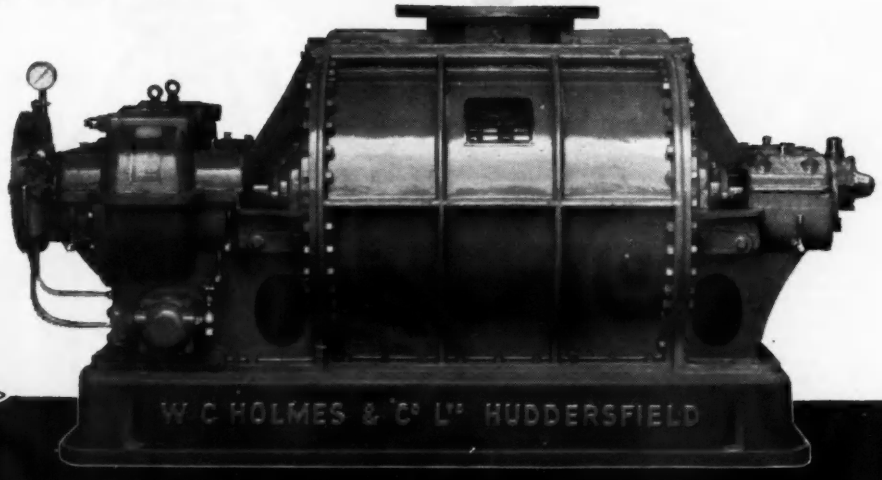
By kind permission of the North Eastern Gas Board.

Oil free ... trouble free

HOLMES-CONNERSVILLE BOOSTERS

The Holmes-Connersville Booster is of extremely robust construction, and with very little maintenance gives continuous trouble-free service. Working pressures of up to 10 lb. per sq. inch.

Full details in Publication No. 36/5



FOUNDED 1850 HOLMES HUDDERSFIELD

W. C. HOLMES & CO. LTD. · TURNBRIDGE · HUDDERSFIELD

C.8279

TYPE 3 MIXTURE CONTROLLER

for accurate control of air blast systems

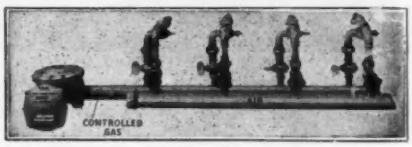
The Type 3 is the latest development in mixture controllers. Its function ensures exact proportioning of air and gas over a wide range of volumes despite the slightest variation of pressures.

Air pressures between ¼ lb. and 1 lb. are used normally but in special instances up to 2 lb. can be used.

Of robust unit construction, the assembly consists of a diaphragm valve, monitor governor and an injector which can be set in any one of four standard positions on site.

The Type 3 mixture controller is available in four sizes 1", 1¼", 1½" and 2". Write or 'phone now for particulars.

The Type 3 zero governor is a modification of the controller. Providing individual control of burners, it gives greater effective control of heat distribution, facilitates burner ignition and has greater sensitivity and range than previous types.



INDUSTRIAL GAS EQUIPMENT

Keith Blackman Ltd
MILL MEAD ROAD, LONDON, N.17
TEL: TOTTENHAM 4522 (12 LINES)

If air blast arrangements are not already installed a K.B. High Pressure fan will provide, as a rule, greater efficiency and economy than a positive blower or compressor of equal capacity. These fans may be supplied with or without K.B. made motors as required.

601

WATERPROOF FIRST AID

Waterproof First Aid Dressings are intended for use when a wound is exposed to water, or contamination from oil, dirt etc., and also where necessitated by hygienic requirements.
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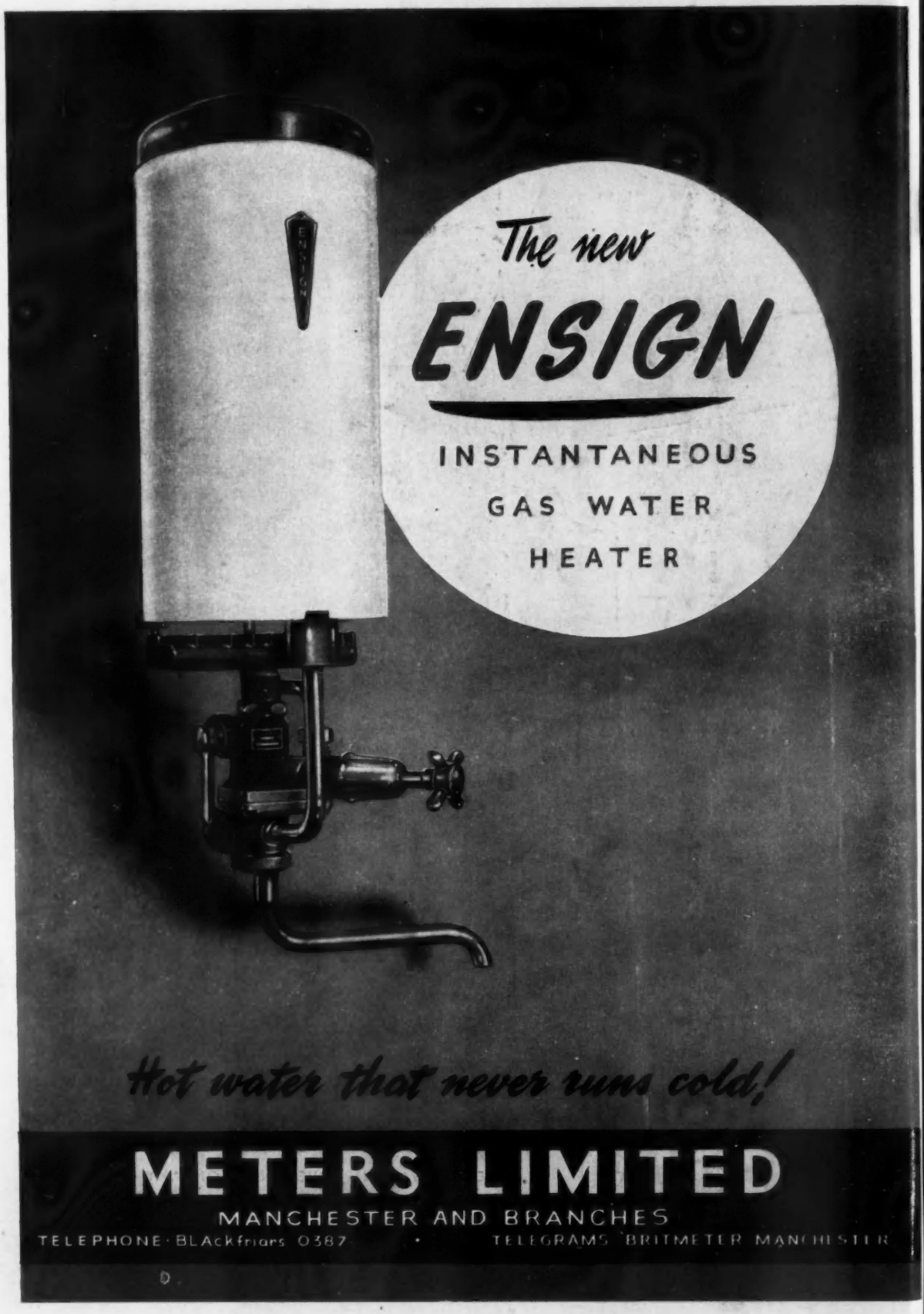
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